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Ministry of Education
Ontario

Box 2

The Honourable Sean Conway, Minister
Bernard J. Shapiro, Deputy Minister

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Curriculum Guideline

Science

Intermediate and Senior Divisions

1987

DRAFT

Part 5: Science, Grades 9 and 10, Basic Level

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The Ontario Institute
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Toronto, Canada

Science, Grade 9, Basic Level (SNC1B)

Core Unit

Body Functions

Optional Units*

1. Gardening
2. Simple Machines
3. Properties of Matter
4. Water World
5. Science and Sport
6. Locally Designed Units (LDUs)

*The optional units selected for the course must include three or more of optional units 1 to 5 and may include LDUs as well.

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Introduction

The Parts of the Guideline

This document is Part 5 of a fifteen-part curriculum guideline that outlines the science program for the Intermediate and Senior Divisions in Ontario schools and describes the science courses that can be offered. The term guideline refers to the entire set of fifteen parts.

This part must be read and implemented in conjunction with Part 1, Program Outline and Policy. When implementing the courses that are described in this document, teachers are to incorporate the many features outlined in Part 1, which will enable them to interpret the overall intent and expectations of the Ministry of Education in the science program. The table of contents for Part 1 is given in Appendix A at the end of this document so that the reader may have ready access to the list of chapters and topics therein.

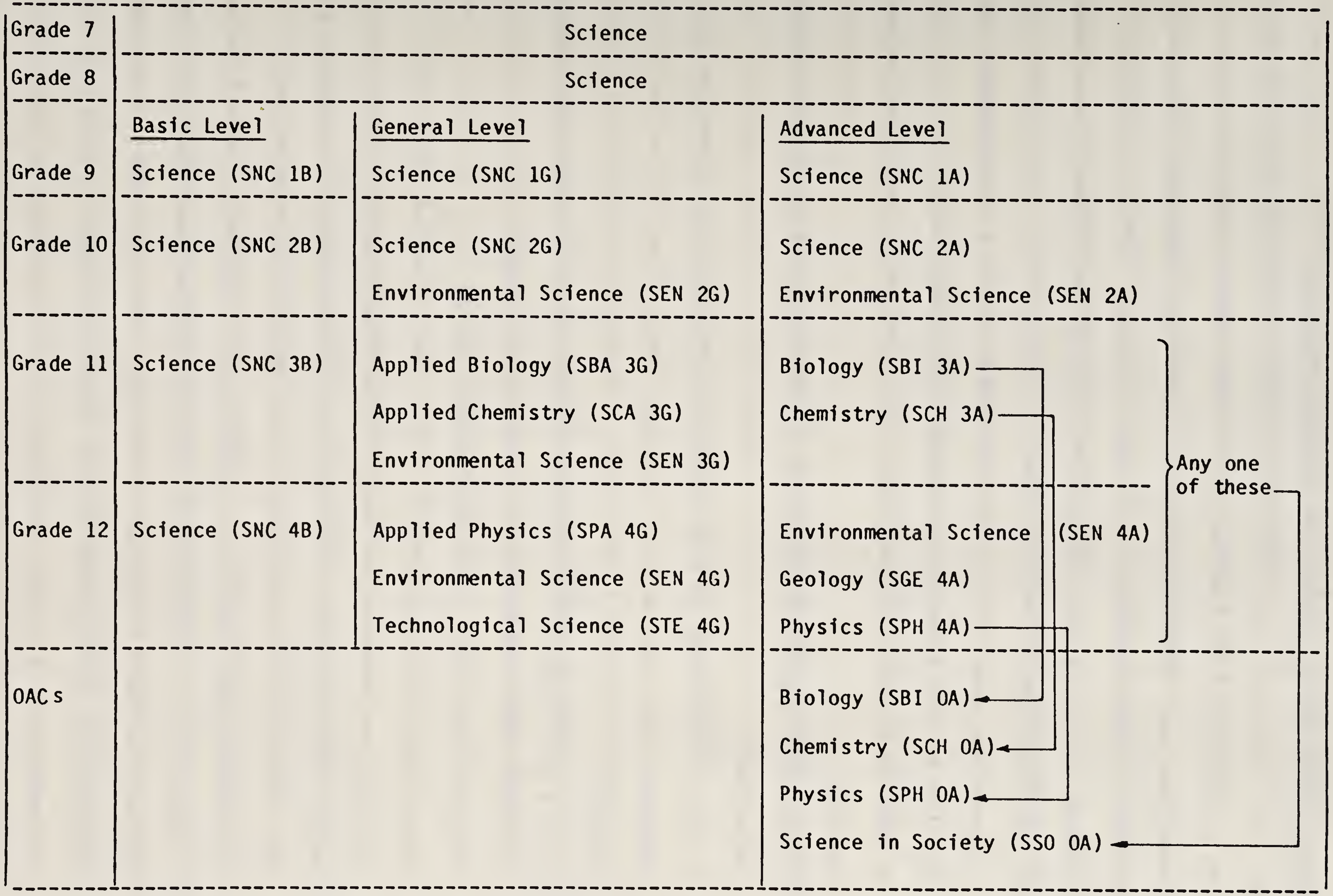
The provincial science program for the Intermediate and Senior Divisions comprises the courses described in Parts 2 to 15. These come under the framework and policy set forth in Part 1. The entire science guideline consists of the following fifteen parts:

Part 1: Program Outline and Policy
Part 2: Science, Grades 7 and 8
Part 3: Science, Grades 9 and 10, General Level
Part 4: Science, Grades 9 and 10, Advanced Level
Part 5: Science, Grades 9 and 10, Basic Level
Part 6: Science, Grades 11 and 12, Basic Level

Part 7: Applied Biology, Grade 11, General Level
Applied Chemistry, Grade 11, General Level
Part 8: Applied Physics, Grade 12, General Level
Technological Science, Grade 12, General Level
Part 9: Biology, Grade 11, Advanced Level
Biology, Ontario Academic Course
Part 10: Chemistry, Grade 11, Advanced Level
Chemistry, Ontario Academic Course
Part 11: Physics, Grade 12, Advanced Level
Physics, Ontario Academic Course
Part 12: Environmental Science, Grades 10 to 12, General Level
Part 13: Environmental Science, Grades 10 and 12, Advanced Level
Part 14: Geology, Grade 12, Advanced Level
Part 15: Science in Society, Ontario Academic Course

The accompanying chart indicates the twenty-seven science guideline courses that may be offered in Grades 7 to 12 and at the OAC level. A list of the science courses with their course codes is given in Appendix B.

Authorized Science Guideline Courses, Intermediate and Senior Divisions



Grade 7	Science			
Grade 8	Science			
	Basic Level	General Level	Advanced Level	
Grade 9	Science (SNC 1B)	Science (SNC 1G)	Science (SNC 1A)	
Grade 10	Science (SNC 2B)	Science (SNC 2G) Environmental Science (SEN 2G)	Science (SNC 2A) Environmental Science (SEN 2A)	
Grade 11	Science (SNC 3B)	Applied Biology (SBA 3G) Applied Chemistry (SCA 3G) Environmental Science (SEN 3G)	Biology (SBI 3A) Chemistry (SCH 3A)	Any one of these
Grade 12	Science (SNC 4B)	Applied Physics (SPA 4G) Environmental Science (SEN 4G) Technological Science (STE 4G)	Environmental Science (SEN 4A) Geology (SGE 4A) Physics (SPH 4A)	
OAC s			Biology (SBI OA) Chemistry (SCH OA) Physics (SPH OA) Science in Society (SSO OA)	

Note: Prerequisites to the OACs are shown by arrows.

Features That Apply Across the Science Program

Part 1 of the guideline specifies a great number of features that are to be integrated into the design of the science program in the Intermediate and Senior Divisions. There are too many of these features to describe in full in each of Parts 2 to 15, but the following will give the reader some idea of the kinds of features that are described. They include:

- information about the science credits that are required for the earning of the Ontario Secondary School Diploma;
- a list of science courses that are prerequisite to other science courses;
- the policy regarding mandatory student activities in the science laboratory;
- a list of the aims of the science curriculum and the various emphases that may be used to blend these aims with scientific content;
- policy governing time allocations for units of study and the order in which core and optional units may be taught;
- stipulations about locally designed units;
- suggestions about preferred routes that students might take through the science program in a secondary school;
- policy regarding the introduction of non-guideline courses, which are subject to the approval of the Ministry of Education;
- recommendations related to exceptional students, individualized instruction, life-management skills, career awareness, the role and evaluation of language in science courses, and a balanced perspective on the role of both girls and boys in science;
- recommendations on the introduction and handling of sensitive issues;
- specific suggestions about resources for the teaching of science;

- ideas about different modes of delivering science courses, including the co-operative education mode;
- policy pertaining to the significant role to be played by measurement and metric units in science courses;
- stipulations related to the treatment of symbols, significant digits, and mathematical problem solving;
- recommendations concerning the roles to be played by calculators and computers in science courses;
- specific directions about safety;
- policy and principles pertaining to the evaluation of student achievement;
- policy regarding differences in the treatment of science courses at the three levels of difficulty;
- many suggestions about implementing the science program.

It cannot be emphasized strongly enough that teachers of science must integrate the policy and recommendations outlined in Part 1 with the teaching of science and cannot simply rely on the course descriptions given in Parts 2 to 15 of the guideline.

The Intermediate Division Continuum

The two courses Science, Grade 7 and Science, Grade 8, together with the science program of Grades 9 and 10, form a continuum that is intended to help students see something of the panorama of science, enjoy the subject, and appreciate its application to their lives and to society in general. This four-year continuum should also prepare many students for further studies in science in their Senior years.

During the Intermediate years the program is intended to provide a diversified approach to the science disciplines and to build on the more unified approach that is characteristic of the Primary and Junior years.

In Grades 7 and 8 students are provided with the opportunity to work for short portions of each course in each of the disciplines: biology, chemistry, physics, and environmental science. This mosaic permits variety and diversity, and allows students to note interrelationships among the sciences. This pattern is continued in Grades 9 and 10 where again the mosaic provides students in basic-level courses with an opportunity to explore the science disciplines within the context of their lives. Optional units of study within a course should be selected to reflect the mosaic approach used in this guideline for Grades 9 and 10.

All teachers of science in the Intermediate years should have some familiarity with the subject matter contained in those science courses that they both do and do not teach so they can minimize overlap among courses and ensure that continuity is provided.

In the planning of the basic-level science program in a school, careful attention should be given to the selection of optional units in each of Grades 9 through 12, particularly if it is desirable to delay some optional units for a year or two.

In the Grade 9 and 10 basic-level science courses, teachers will have to be sensitive to the varied needs and abilities of students and adapt the science courses accordingly. This may involve the special tailoring of the units of study for some students; remedial work in some units for students with an insufficient background; and a full treatment of each unit of study for other students.

Credit Requirements at the Basic Level

Two science credits are among the compulsory credits required for the earning of the Ontario Secondary School Diploma, and one science credit is needed for the Certificate of Education. It is strongly recommended that students take the Grade 9 basic-level course first, followed by the Grade 10 course. If a student has not taken Grade 9 or 10 science and later decides to include science in his/her program, he/she may take a Senior basic-level science course without having completed an Intermediate course. However, this procedure is not recommended.

Basic-level science courses may be offered in segments for fractional credit value, but in such courses the core unit in each course must be offered in the first segment.

Curriculum Emphases

It is recommended that teachers organize each of the courses described in this document around a particular curriculum emphasis or set of emphases. Such emphases give the curriculum a special focus that can be introduced in addition to the content and processes outlined in the courses. This approach is discussed in section 3.4, "Curriculum Emphases - Blending Curriculum Aims With Content", of Part 1 of the science guideline. In that section there is a list of emphases given in table 2. These emphases will enhance the development of the science courses described in this document. A particular emphasis, that is stressed throughout an entire course or for one or more units at a time, needs to be highlighted so that it becomes a focal or integrating theme.

Student Activities

In each unit of study there is a section entitled "Student Activities". The teacher must select at least one-half of these activities and must include those that are marked with an asterisk. This selected set is then mandatory and must actually be performed by the students themselves. The teacher may permit the substitution of equivalent activities where appropriate. If time and circumstances permit, the teacher should encourage students to do some of the other activities as well. However, such additional activities may be demonstrated by a student or the teacher or may be discussed in conjunction with a textbook, film, computer program, or other learning material used as a resource.

Generally, the best approach to the teaching of science is to ensure that the content develops directly from related student activities. In each unit of study the skills and processes of scientific work should be presented as the central component, from which the subject matter, applications, and implications emerge.

Safety

Safety awareness must be developed in all science students. Constant attention to accident prevention is to be stressed in all student activities and teacher demonstrations in the laboratory. Section 9, "Safety", in Part 1 of the science guideline contains comprehensive subsections entitled:

- Safety in the Laboratory
- Some Recommended Safety Procedures
- Animal Care in Science Courses
- The Safe Use of Plants

In each unit of study, subsection 6, "Safety Considerations", acts as a reminder of some of the safety features that pertain to the unit in question. General reference, however, should constantly be made to the safety section in Part 1. Schools must always remain on the alert in regards to safety and maintain an up-to-date safety-awareness program.

Sensitive Issues

The curriculum outlined in this science guideline places a distinct emphasis on the science-technology-society connection. For this reason scientific applications and societal implications are mandatory components of each unit of study. In addition, Part 1 of this guideline underlines the need to incorporate morals/values education in science courses. Undoubtedly, this will give rise to the discussion of some sensitive issues.

Such discussions are important. Generally, they should be focused and provide an open forum for the expression of different viewpoints. In this regard teachers of science are urged to be familiar with section 10, entitled "Values in Science Education", in Part 1 and pay particular attention to the principles to be observed when dealing with sensitive issues in the science curriculum. These principles are mentioned in section 10.2 of Part 1.

Locally Designed Units

The local design of some optional units is permitted in the courses described in this document. A locally designed unit (LDU) is included to allow teachers, at their own discretion, either to introduce an appropriate new area of science not described in the guideline or to include additional new work that will expand on previous parts of the course. At the end of each core and optional unit some topics are suggested for possible use in expanding existing units or developing new ones. The design of an LDU may also focus on a science project. In this case care should be taken to ensure that students participate in projects that differ from those done in Grade 7 or 8. Appropriate objectives, student activities, applications, and societal implications, as well as evaluative criteria and safety suggestions, must be included in an LDU.

Evaluation of Student Achievement

In each unit of study described in the courses outlined in this document, section 5, "Evaluation of Student Achievement", specifies certain items that must be included in the students' term marks (exclusive of formal examinations) when their achievement is evaluated. In most units teachers are required to evaluate students' activities and related laboratory reports. However, the proportion ofthe mark assigned will vary from one teacher to another. In order that the experimental component of science be emphasized, the overall mark for an entire science course must include at least fifteen per cent for the evaluation of student achievement in laboratory skills and reports.

Cross References

In the descriptions of each unit of study in the courses outlined in this document, cross references are provided in parentheses. These are included to provide some examples of the relationships that exist among the parts of the unit.

Particular Features of the Grade 9 and 10 Basic-Level Science Courses

Units of Study and Their Time Allocations

The following charts provide an overview of the units of study in Grade 9 and 10 science at the basic level. They also indicate the approximate amount of time to be allotted to each unit.

Science, Grade 9, Basic Level (SNC1B)

Units of Study	Time Allocations	
Core		
Body Functions	Up to 30 h	
Optional*		
A selection from among the following:		
1. Gardening	20 h	
2. Simple Machines	20 h	
3. Properties of Matter	20 h	80 h
4. Water World	20 h	
5. Science and Sport	20 h	
6. Locally Designed Units (LDUs)	20 h	
		110 h

Science, Grade 10, Basic Level (SNC2B)

Units of Study	Time Allocations	
Core		
World Beyond	Up to 30 h	
Optional*		
A selection from among the following:		
1. Fibres and Fabrics	20 h	
2. Sun, Skin, and Eyes	20 h	
3. Science and Health	20 h	80 h
4. Outer Space	20 h	
5. Science and Food	20 h	
6. Locally Designed Units (LDUs)	20 h	
		110 h

*The optional units selected for each course must include three or more of optional units 1 to 5 and may include one or more LDUs as well.

Particular Features of the Grade 9 and 10 Basic-Level Science Courses

Aims of the Basic-Level Science Program

Science courses at the basic level are to meet the needs, abilities, and interests of the students within a particular school community. For this reason the purpose and meaning of these courses must be made clear to students, and teachers must ensure that the scientific content and processes included in the courses are applicable to students' lives. Courses are to be designed so that they are practical and experimental and so that they provide students with the opportunity to experience success.

Students who take science at the basic level will have the opportunity to develop:

a) a feeling of self-worth (e.g., confidence, self-discipline, and satisfaction with their achievement);
b) work-related skills (e.g., time-management skills, fine-motor development, communication skills, the ability to attend to a task and to follow instructions);
c) an understanding of societal issues as they relate to science (e.g., genetic engineering, alcohol addiction);
d) an awareness of environmental issues (e.g., acid rain, water pollution, waste disposal);
e) an appreciation of the role that science plays in their lives (e.g., medicine, consumer chemistry, astronomy, combustion, first aid);
f) the ability to work and communicate with their peers.

The attitudes and skills that students will require in managing their lives, finding success in employment, and assuming social responsibility should form the basis for the curriculum at the basic level. Science is a medium through which these attitudes and skills can be developed and reinforced.

Design of Local Courses

Basic-level science courses must differ from general- and advanced-level science courses. Since students enrolled in basic-level science courses have very diverse backgrounds in science, their programs must be adapted to suit the needs and experiences of the individual or class and at the same time provide them with a scientific emphasis and intellectual challenge. In the outline of courses in this document, an attempt has been made to give a reasonable balance between direction and flexibility.

Basic-level courses, like all of the Intermediate and Senior Division science courses, are composed of units of study. However, the units of study in basic-level courses are much more flexible and open-ended than are those in other courses.

In general- and advanced-level courses all of the objectives are prescribed. In basic-level courses the objectives and certain other components are to be selected from the course descriptions according to the following conditions:

a) From among each of the categories - attitudes, skills, and knowledge - at least one-half of the objectives are to be included.

b) At least one-half of the student activities, including all those marked with an asterisk, are to be included.

c) Skill objectives and student activities should be related.

d) At least one-half of the applications and the societal implications are to be included.

e) Where the evaluation of student achievement is directly related to mandatory student activities, such evaluation is also to be included.

f) Safety precautions are essential.

Each unit of study should be treated not as a rigid body of knowledge, but as a theme that can be flexibly developed to suit students' interests, needs, and abilities. Special adaptations are to be made for exceptional students. The possible extensions and teaching suggestions are important components as well.

In the overall design of a Grade 9 or 10 basic-level science course, the optional units that are chosen and any locally designed units that are developed should be such that the program gives students a balanced exposure to topics in biology, chemistry, physics, and environmental science.

Each course shall consist of one core unit, which is to be allocated up to thirty hours of class time. At least three additional units are to be selected from the optional units 1 to 5. Each of these should be allocated up to about twenty hours. Any remaining time may be used for more of these optional units or for locally designed units. Optional units from an earlier basic-level course that have not been taught previously in the school may be included. It is strongly recommended that at least five units be studied in a given full-credit course. The time spent on any optional unit is limited to about twenty hours to provide for a broad range of units and to prevent boredom caused by overemphasis on any one unit.

Objectives for Basic-Level Science

When designing the basic-level science program, teachers and curriculum committees are to emphasize general objectives related to attitudes, skills, and knowledge. In this introduction, overall knowledge objectives are not enunciated, since specific knowledge objectives are contained in each theme along with additional specific attitude and skill objectives. All goals, aims, and objectives should focus on students' interests and abilities in order to enrich their present lives and to prepare them for the future.

The attitude and skill objectives, as well as the mastery of subject matter, are essential components of each unit. Students must be given ample time to develop positive attitudes and to experience hands-on activities. The criterion for selecting and developing topics within each unit should be the perceived needs and interests of the students, particularly in the areas of attitudes and practical skills.

Attitudes. Students will be encouraged to develop:

a) a willingness to accept praise when work is well done;
b) an accepting attitude towards constructive criticism that is intended to help them learn and mature;
c) a willingness to accept responsibility;
d) a respect for the rights of others;
e) a concern for the progress and welfare of their classmates;
f) commitment to the idea that an attitude of trust and trustworthiness enhances friendships;
g) loyalty to self, family, and society;
h) a commitment to work well and to prepare with others in the science classroom for the world of work;

i) a commitment to recognize their strengths and limitations and to apply their capabilities;
j) a concern for the environment;
k) an inquisitive attitude towards life and nature;
l) an interest in the relationships between science and technology.

Skills. Students will have the opportunity to improve their proficiency in:

a) the communication skills of listening, speaking, writing, reading, and viewing;
b) performing arithmetic operations, such as adding, subtracting, multiplying, dividing, and estimating;
c) safely using simple apparatus such as measuring devices (linear, temperature, volume, mass), microscopes, heating equipment, and simple dissection equipment;
d) following verbal and written instructions;
e) following directions in sequence when performing experiments;
f) the process skills of science, such as observing, classifying, interpreting, inferring, predicting, summarizing, and evaluating;
g) recording meaningful data in notes, charts, diagrams, and graphs;
h) preparing and writing up experiments;
i) managing their time during class and developing positive study habits;
j) maintaining a notebook and using it as a reference source;
k) using information sources such as libraries, computers, and magazines.

Knowledge. While specific science content is important in teaching skills and influencing attitudes, it should not be given as high a priority in basic-level courses as in advanced- and general-level courses. This approach is reflected in the flexibility allowed in the selection of subject matter in each of the units described in this document. Also, while subject matter should not be treated with undue rigour, it is, nevertheless, important that students in basic-level science courses realize that they are developing intellectually and gaining a good understanding of scientific phenomena.

The development of good language usage should be an important feature of basic-level science. However, the scientific vocabulary and expressions implied in the knowledge objectives may require some simplification to be made appropriate to the students in the course.

The method of instruction must reflect the unique needs of students studying at the basic level. It is essential for the teacher to be aware of each student's adolescent characteristics and behaviour, to create a feeling of acceptance and encouragement, and to provide and maintain meaningful routines. Numerous opportunities should be provided for students to participate in activities of various kinds to match their varied learning styles.

Evaluating Student Achievement

As part of the positive climate within the classroom, the evaluation of student achievement must nurture self-worth and a sense of accomplishment. While the evaluation of objectives is important for the completion of each unit, consideration must be given to the progress and development of individual students throughout the whole course. Personal skills and attitudes related to co-operation, time management, manners, and effort must be included in the evaluation plan. Frequent and immediate feedback will promote in students a feeling of achievement and self-image, and this will foster a positive attitudes towards the teacher, the subject, and the course.

Student achievement may be evaluated through a variety of methods such as the following:

a) considering students as individuals who are achieving at their own level and assessing their personal progress through an assessment of their notebooks, oral reporting during practical work, daily work, and term projects
b) giving tests before and after a unit of study
c) basing assessment on individual contracts when there is a wide range of abilities within a single class
d) grading a student's contribution to the class when he/she submits or reports on newspaper articles and other material brought in from outside the classroom as extra work
e) restricting examinations and other summative testing to comparatively short portions of a course and using a wide range of evaluation techniques

For further suggestions on evaluation see section 14 of Part 1 of this guideline.

Science, Grade 9, Basic Level (SNC1B)

Core Unit

Body Functions

Optional Units*

1. Gardening
2. Simple Machines
3. Properties of Matter
4. Water World
5. Science and Sport
6. Locally Designed Units (LDUs)

*The optional units selected for the course must include three or more of optional units 1 to 5 and may include LDUs as well.

Science, Grade 9, Basic Level (SNC1B)

Core Unit

Body Functions

Time: Up to 30 hours

All students should have a basic understanding of the biological principles that relate to the human body. In this core unit students will acquire basic information about the body and how it functions and will learn through laboratory activities about the interdependence and functions of the various organs of the body. The particular content of the unit should be chosen in consultation with teachers of the health education program so that the science and health programs are complementary.

This unit may be divided into topics such as the following:

- Healthy skin
- Eating
- Breathing
- Reflex action
- Bones and muscles

Objectives

At least one-half of the items in each of the following categories of objectives are to be selected when planning the teaching of this unit.

Attitudes. Students will be encouraged to develop:

a) an attitude of co-operation when working in a group;

b) a commitment to improving the quality of their lives by maintaining a healthy body (3a, 3d, 4d, 4a);

c) curiosity about their bodies and how they function (2b-2g);

d) a concern for the health and general well-being of all humans (4a, 4c).

Skills. Students will have the opportunity to develop skill in:

a) recording and organizing data from an activity sheet (2a);
b) interpreting data from observations;
c) manipulating laboratory equipment, such as a hand lens, microscope, thermometer, stethoscope, and sphygmomanometer (2b, 2d, 2e);
d) following procedures for good hygiene (2c, 2h);
e) mapping the tongue for the major areas of taste or the skin for sweat pores and for nerve sensors (2b);
f) recording and measuring lung volume, heart rates, and blood pressure (2d, 2e);
g) locating reflex areas in the body (2f);
h) using the library to obtain resource material (2h).

Knowledge. Students will be expected to:

a) identify features on the skin such as hair, sweat pores, fingernails, freckles, and wrinkles (2b);
b) state the functions of the skin (2b);
c) outline proper hygienic procedures for skin care (2b);
d) identify and state the functions of parts of the mouth, for example, the teeth, tongue, and salivary glands (2c);
e) explain the action of enzymes in saliva on starch (2c);
f) identify the parts and describe the function of the respiratory system (2d);
g) explain how to find a pulse point and the pulse rate (2e);
h) identify the parts and describe the function of the heart (2e);

i) identify two reflex actions (2f);

j) explain the relationship between the structure and function of the skeletal and muscular systems (2g);

k) identify regions of the body that have voluntary and involuntary muscles (2g);

l) describe the importance of exercise and fitness to the well-being of the body (e.g., lung capacity, heart rate).

2. Student Activities

Students are to:

a) recall and record data on their activities for one day (24 h) and present this information in an oral or written report (8a);

*b) (i) examine with a hand lens, or a microscope, the structure of the skin for the presence of hair, sweat pores, fingernails, freckles, and wrinkles or (ii) prepare a map of sweat pores on two different surfaces of the body or (iii) prepare a skin map of the nerve sensors (touch, pain, heat, cold) of the forearm and calf (5c, 6d, 8b, 8d, 8e);

c) (i) observe the structure of human teeth by examining models or diagrams or (ii) practise oral-hygiene techniques and use disclosing tablets to illustrate plaque or (iii) demonstrate the action of the enzyme amylase on starch or (iv) map taste regions of the tongue or (v) examine human cheek cells under the microscope (6b, 8f);

*d) (i) use a stethoscope to listen to breathing sounds or (ii) measure total lung capacity or (iii) examine the structure of the respiratory system in a preserved specimen such as a fetal pig (5d, 6a, 6c, 6d, 8g);

e) (i) listen to the sounds made by the heart or blood at pulse points and measure pulse rates before and after exercise or (ii) measure blood pressure using a sphygmomanometer or (iii) examine a preserved heart of a mammal such as a cow to determine the structural parts of the heart or (iv) investigate the effect of exercise on body temperature, blood pressure, and breathing rate (6a, 6c, 6f, 8g, 8h);

*f) locate reflex areas in the body by gently tapping the knee and inside elbow with a rubber hammer (8g);

g) (i) examine a skeleton to determine the locations of at least four joints or (ii) locate voluntary muscles in the body;

h) give a written or oral report based on one of the following: (i) the importance of good food habits to the maintenance of a healthy body; (ii) the effects of smoking, alcohol, and drugs on the body; (iii) the signs of health and hygiene in a healthy body.

*See the subsection entitled "Student Activities" on page 8.

3. Applications

a) Proper hygiene is essential for personal health.

b) A knowledge of the relationships between body structures and their functions can lead to a better understanding of health and the prevention of disease.

c) Drugs, such as alcohol, that affect reaction time should be avoided, particularly prior to an activity such as driving a car.

d) Proper fitness and exercise programs are important for the well-being of the body.

4. Societal Implications

a) A variety of careers in the health sciences are available to students with an interest in the human body.

b) Trainee and instructor-training programs in first aid are available to students.

c) An interest in fitness and exercise can lead to careers in these areas.

d) A knowledge of the effects of alcohol and drugs on the senses should lead to a reduction in their abuse.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on such activities as students':

a) use of charts in recording data;

b) use of laboratory equipment, such as the microscope, stethoscope, or clinical thermometer;

c) ability to identify parts of the skin, mouth, respiratory system, or heart;

d) ability to determine pulse, lung volume, or body temperature;

e) completion of practical laboratory assignments;

f) written or oral presentations.

6. Safety Considerations

a) Students should wear protective eyewear and gloves when dissecting preserved specimens.

b) Students should be surveyed for allergies to foods prior to performing taste tests.

c) Students should wash their hands after using chemicals or handling specimens.

d) Students should be informed of the appropriate techniques for the care and handling of laboratory equipment (e.g., the compound microscope, stethoscope, and sphygmomanometer).

e) Thermal strips or appropriate sterile thermometers should be used in measuring body temperature.

f) Students with medical problems should not perform stressful activities (e.g., exercise in order to obtain body-temperature and lung volume measurements).

7. Possible Extensions

Some students might:

a) prepare daily food-intake charts;

b) investigate different hair types and skin textures;

c) investigate any of the body systems in greater depth;

d) trace the path of food from the mouth to its absorption into the blood;

e) prepare a summary of the effects of smoking on lung capacity;

f) determine how oxygen enters and leaves the lungs;

g) examine the interaction of bones, muscles, and tendons in a joint such as the knee;

h) invite a fitness instructor or school nurse to the classroom to explain the importance of proper health, exercise, and hygiene to the body;

i) gather information from the school guidance office on careers available in the areas of health, hygiene, and fitness.

8. Some Teaching Suggestions

a) The information that students gather about their health activities can be recorded on a data sheet according to the time of day during which the activities were performed (e.g., before school, before noon, afternoon, after school, evening). This information can be used to assess students' level of competency in following instructions, language level, and ability to complete a task.

b) Students should be encouraged to work in small groups.

c) Word puzzles help students to recall scientific words. They can be used as a review.

d) A dilute solution of iodine (0.01 mol/L) can be painted on the skin to determine the distribution of sweat pores. The edge of the palm and the wrist are suitable areas. The size of the area to be tested should be about the size of a twenty-five-cent coin. After the iodine dries, the areas to be tested can be dusted with cornstarch or powder. After three or four minutes the painted areas should be pressed onto blank paper. In this way a print of blue dots indicating the sweat pores should be obtained.

e) A grid of about 3 cm x 3 cm can be used in the preparation of the nerve-sensor map. The sensations of heat, cold, pain, and touch can be tested for by means of a hot nail (heated in water), ice cubes, a small pin, and fine wire respectively.

f) Dental charts, disclosing tablets, and models of teeth are available from commercial suppliers or from local health services.

g) A school nurse, if available, may assist in instructing students on the use of the stethoscope, determining lung capacity, and locating reflex areas.

h) Students can discuss the effects of diet on the basis of their observation of cow or sheep heart or lung specimens that have fatty deposits. Students can investigate the placement of the cow or sheep valves in the heart.

i) The teacher-librarian should be consulted regarding the planning of the research topic so that appropriate materials will be available. The guidance and physical and health education departments may also have useful resource materials that could be suitable for student use.

j) The following are examples of new topics or units that can be developed from this unit:

Topics in This Unit	Additional Topics or Units
Healthy skin	Cells and microscopes Fingerprinting Animal coverings
Eating	Nutrition Fast foods Digestive system
Breathing	Smoking and the respiratory system Circulatory system
Reflex action	Sports and reflexes Nervous system
Bones and muscles	Simple machines Building structures First aid

Science, Grade 9, Basic Level

Optional Unit 1

Gardening

Time: About 20 hours

Plants are an essential part of our daily lives, but their contributions to it are usually taken for granted. A growing interest in house plants and in home gardening in Canada is leading to a greater awareness of the importance of plants. This unit illustrates, by examining the characteristics and needs of flowering plants, how the application of basic principles can lead to the enjoyable hobby of successfully growing plants.

This unit may be divided into topics such as the following:

- Structure of flowering plants
- Requirements for growth
- Plant reproduction and propagation
- Seeds and fruits
- Importance of plants

1. Objectives

At least one-half of the items in each of the following categories of objectives are to be selected when planning the teaching of this unit.

Attitudes. Students will be encouraged to develop:

a) an appreciation for the need to treat soil as a resource that must be conserved (3a);

b) an awareness of the part that plants play in the lives of all living things (3d);

c) an appreciation of the aesthetic value of plants in our homes, gardens, and communities (3c, 4b, 4c);

d) a concern for the need to protect plant species and to conserve green space (3e);

e) an appreciation of the fact that agriculture, forestry, and many food-producing industries are completely dependent on plants that must be managed and cared for by humans (4a);

f) an interest in the wide variety of plants.

Skills: Students will have the opportunity to develop skill in:

a) preparing a potting soil mixture (2a);

b) sterilizing soil (2c);

c) carrying out the following techniques: potting, making cuttings, seeding, transplanting, repotting, pruning, watering, and fertilizing (2b);

d) observing plant parts using a hand lens or a microscope (2e);

e) making careful observations and communicating those observations accurately in oral or written form;

f) testing for starch using iodine (2g);

g) handling and using garden chemicals (e.g., rooting hormones, insecticides, herbicides, fertilizers) safely and efficiently (2b);

h) following oral and written directions for measuring the water-retention and percolation rates of soil and its components (2h);

i) using a bar graph to represent and compare experimental results (2h);

j) using experimental results to form a conclusion (2h).

Knowledge. Students will be expected to:

a) list the components of potting soil, clay, humus, and sand (2a);

b) describe the property that each soil component contributes to a potting-soil mixture (2a);

c) describe why rooting hormone is used (2b);

d) give reasons why soil must be sterilized (2c);

e) compare different types of plant roots, such as tap roots and branching roots;

f) explain the role of a root system in plant growth and in soil conservation;

g) describe geotropism and phototropism in roots, stems, and leaves;

h) identify from a diagram the parts of a plant, including roots, stems, buds, leaves, and flowers;

i) match the functions of plant parts with their names;

j) identify from a diagram the parts of a flower, including the stamens, pistil, pollen, ovary, seeds, and petals (2e);

k) match the functions of flower parts with their names (2e);

l) explain the function of xylem and phloem and relate this function to the production of maple syrup (2f);

m) briefly describe the stages of energy conversion in plants in the processes of photosynthesis, starch formation, and respiration (2g);

n) list two common foods obtained from each plant part (2i).

2. Student Activities

Students are to:

a) prepare a potting-soil mixture (5b, 6a);

*b) propagate a plant from a cutting and care for it (5b, 5d, 6a, 6b, 8c-8f);

c) prepare sterilized soil and use it for germinating seeds (6a, 6c);

*d) germinate seeds and describe the changes that occur as the plant develops (6a, 8b, 8g, 8h);

e) examine a simple flower and identify the petals, stamens, pollen, and pistil (5a, 6e, 8i);

f) carry out an experiment to demonstrate the movement of water through stems and leaves and examine the cross section of the stem used;

*g) examine different seeds and fruits and test for starch content (5c, 6a);

h) measure the water-holding capacity and percolation rate of potting soil and each of its components (6a);

i) group common foods according to the part of the plant that is used (6d).

Note: Students should be encouraged to perform some of the above activities in a garden or using material from a garden if this is feasible.

*See the subsection entitled "Student Activities" on page 8.

3. Applications

a) Potting soil can be prepared to suit the specific needs of different plants.

b) The growing conditions of plants can be controlled to provide for optimum growth.

c) Growing plants can be a source of pleasure and satisfaction as the results of good care are seen.

d) Plants provide a means of harnessing, storing, and transferring the sun's energy to all living things.

e) Trees must be protected from girdling of the bark.

f) Plants are a source of food and medicinal compounds.

4. Societal Implications

a) The management of plant growth is the basis on which important Canadian industries such as agriculture and horticulture have grown.

b) Potted flowers, house plants, and flower beds make our homes, buildings, and communities more attractive.

c) The growing of plants can provide an inexpensive interest for everyone and has the potential to supplement food supplies and increase income.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on such activities as students':

a) ability to identify plant structures;

b) skill in preparing a potting-soil mixture;

c) tests for starch in seeds and fruits;

d) care and growth of a plant.

6. Safety Considerations

a) Students should wash their hands after handling soil, hormones, fertilizers, fungicides, treated seeds, Lugol's solution, and all other garden chemicals.

b) Students should use sharp scissors rather than open blades when making cuttings.

c) Students should be careful to avoid burns when sterilizing soil.

d) Students should not eat or taste any of the plants used in class unless instructed to do so by the teacher.

e) Students should notify the teacher if they have allergies to plant materials.

7. Possible Extensions

Some students might:

a) investigate the vegetative propagation of plants, using spider-plant runners, potato eyes, or carrot tops;

b) investigate hydroponic gardening and aquaculture;

c) grow herbs and discuss their uses;

d) demonstrate the production of oxygen by plants when exposed to light;

e) demonstrate the uptake of water by osmosis in a carrot or a potato;

f) examine a cross section of a log, noting its parts, counting its rings, and noting the evidence that indicates differences in the spring and summer growth of previous years;

g) test for the presence of starch in leaves exposed to light and darkness or in the different coloured zones of a coleus leaf;

h) provide bedding plants for the school or provide and care for plants in school offices or other locations;

i) investigate the use of plant parts to make dyes and for the extraction of scents or flavours;

j) investigate the effect of different variables on plant growth (e.g., soil-nutrient levels, light, moisture).

8. Some Teaching Suggestions

a) A new plant, an interesting poster, or a demonstration can be used as a focus of interest to begin each activity or lesson. A wide variety of media and printed materials should be used to supplement each activity.

b) Used styrofoam cups or burger containers provide good containers for plants and for starting seeds. Used pots and hanging baskets can often be obtained at little or no cost from florists or garden centres.

c) Motivating reasons for growing the plants should be provided. Plants can serve as gifts, as decoration for the office or school grounds, or as food to be eaten.

d) Cuttings are easily grown from most plants, including geranium and coleus.

e) The principles of pruning and further cuttings can be demonstrated to show how a single cutting can produce a lush plant.

f) Rooting hormone can be used to increase the success of cuttings.

g) Bean seeds should be soaked in water containing a little fungicide for twenty-four hours before germination.

h) Seed germination and pot rotation provide a means of illustrating tropisms and using them to produce better growth.

i) Flowers may often be obtained for examination from a florist's old stock of cut flowers. Alyssum is a good plant to use with a hand lens or a microscope.

j) The following are examples of new topics or units that can be developed from this unit:

Topics in This Unit	Additional Topics or Units
Structure of flowering plants	Uses of plants
Requirements for growth	Health and nutrition Horticulture
Plant reproduction and propagation	Insects and pollination Hybrids
Seeds and fruits	Edible plants
Importance of plants	Forestry Poisonous plants Fungi The food industry

Science, Grade 9, Basic Level

Optional Unit 2

Simple Machines

Time: About 20 hours

Simple machines, such as the lever, inclined plane, and pulley, can be used to make everyday work easier. In this unit students will complete activities to investigate how this happens. A common device such as the bicycle which is composed of many simple machines, could be the focus of the unit.

This unit may be divided into topics such as the following:

- Levers
- Inclined planes
- Pulleys
- Friction

1. Objectives

At least one-half of the items in each of the following categories of objectives are to be selected when planning the teaching of this unit.

Attitudes. Students will be encouraged to develop:

a) a questioning attitude towards the effects of machines on society (3b, 4b, 4c);

b) an appreciation for the scientific principles present in simple machines (2b, 2c, 2e);

c) honesty in presenting their findings.

Skills. Students will have the opportunity to develop skill in:

a) making measurements to refine their observations;

b) classifying machines according to their characteristics (2b);

c) controlling variables in an experiment (2g);

d) handling equipment in a safe manner (2);

e) making a generalization from observations (2c, 2g);

f) recording information on charts and graphs (2b, 2d);

g) calculating the speed of an object moving over a fixed distance (2h).

Knowledge. Students will be expected to:

a) describe how a lever is used and give examples of devices that contain levers (2b);

b) give examples of the use of inclined planes to make work easier (2c);

c) describe how a fixed pulley operates (2e);

d) explain how several pulleys can work together, such as in a block and tackle (2e);

e) list the simple machines that are part of a common device (e.g., a bicycle);

f) list various ways of reducing friction (2g);

g) describe a simple method for determining the centre of gravity of an object (2a);

h) state the metric units used to measure distance, speed, mass, and force.

2. Student Activities

Students are to:

*a) construct a balancing mobile using dowelling, string, cans, and cardboard and determine the position of the centre of gravity ofseveral objects (8b);

*b) conduct an experiment to investigate the lifting capacity of first-class levers, second-class levers, and third-class levers (5c, 8c, 8g);

c) conduct an experiment to investigate the use of an inclined plane to make work easier;

d) conduct an experiment to investigate the gear ratios of a ten-speed bicycle, for example, the relationship between crank speed and wheel speed (6c);

e) conduct an experiment to assemble, operate, and compare the loading and lifting potential of a fixed pulley, a block and tackle with one fixed pulley and one movable pulley, and a block and tackle with two fixed pulleys and two movable pulleys (6b);

*f) demonstrate the effects of inertia of stationary masses and moving masses;

g) investigate various methods of reducing friction by testing different surfaces and lubricants (8a);

h) conduct an experiment to determine the speed, over a fixed distance, of a bicycle or other moving object (6a);

i) conduct an experiment to investigate the relationship between the ease of movement of a vehicle and the pressure of air in the tires (8h).

*See the subsection entitled "Student Activities" on page 8.

3. Applications

a) Gears and pulleys are used extensively on production lines.

b) The building trade frequently uses the lever concept (e.g., hammer, crowbar, wheelbarrow).

c) Sturdy structures have a low centre of gravity.

d) The braking systems of motor vehicles rely on friction.

4. Societal Implications

a) The centre of gravity of structures must be considered in architectural designs.

b) The use of simple machines such as levers and gears may make an industry more cost-efficient.

c) The development of complex machines has made work easier.

d) Improper automobile tire pressure or defective machine parts can cause traffic accidents.

5. Evaluation

At least 50 per cent of the term mark for this unit is to be based on such activities as students':

a) participation in laboratory work;

b) manipulation and use of laboratory equipment (e.g., triple beam balance, spring balance, stopwatch, linear-measurement apparatus);

c) manipulation and use of levers;

d) ability to observe and accurately record data;

e) daily assignments and exercises.

6. Safety Considerations

a) If a bicycle is used for any of the activities appropriate precautions should be taken.

b) Care should be taken in lifting heavy packages and objects.

7. Possible Extensions

Some students might:

a) study the functions of levers in the human body;

b) construct a pulley system to lift a person;

c) examine how bicycling alters the heart rate and breathing rate;

d) investigate the relationship between the slope of an inclined plane and the final speed of an object going down it;

e) visit the auto shop and investigate the gears and levers of an automobile;

f) calculate a gear ratio.

8. Some Teaching Suggestions

a) The auto shop will have a supply of ball bearings. Marbles are an excellent means for rolling objects to illustrate how wheels can reduce the effort needed to move a load.

b) The concept of centre of gravity can be demonstrated by means of a metre stick, pieces of cardboard or plywood, and containers that have a variety of heights and diameters.

c) Students can discuss and illustrate many uses of levers and can show how the lever principle is used in common objects (e.g., hammer, shovel, crowbar, scissors, bottle opener).

d) A bicycle can be ridden down a slight slope several times under varying conditions and the coasting distances of the bicycle compared according to the mass of the rider, position of the rider, initial speed, or amount of wind resistance.

e) Objects of various shapes can be rolled across the floor to illustrate the benefits of the wheel. Ball bearings can be used to move a heavy mass across the floor. A cement block can be pulled over various surfaces, such as sand, asphalt, grass, or concrete, to illustrate differences in friction. Forces can be measured with newton spring scales.

f) Gear ratios can be investigated by means of a bicycle. A spring scale can be attached to the pedal, and the force needed to begin moving the rear wheel can be recorded. This activity can be repeated with different gear ratios. The relationship between the force and the gear size can be determined. The different gear ratios present on five- and ten-speed bicycles can be investigated.

g) A teeter-totter can be used to investigate a lever. A known mass can be placed at one end of a teeter-totter. The masses necessary to balance the known mass at different distances from the fulcrum can then be investigated.

h) A tire gauge can be used to record the tire pressure of a bicycle with and without a person sitting on the bicycle. The relationship between the masses of several people and the resulting tire pressures in the tire can be examined. The difficulties in riding a bicycle with over- or underinflated tires can be discussed.

i) The following are examples of new topics or units that can be developed from this unit:

Topics in This Unit	Additional Topics or Units
Levers	Wheel and axle Mobiles Skeletal and muscle systems
Inclined planes	Wedge Screw
Pulleys	Gears and transmissions
Friction	Lubrication

Science, Grade 9, Basic Level

Optional Unit 3

Properties of Matter

Time: About 20 hours

An understanding of the properties of matter has led to the development of many materials and products that are useful to society. The utilization of the properties of a substance may be quite simple or as complex as the silicon chip. The properties of matter are used all around us, from the salt in cooking to the materials in buildings. In this unit students will focus on using observation and measurement skills in conducting experiments to investigate the properties of some common substances.

This unit may be divided into topics such as the following:

- Comparing properties
- Solubility
- Changes of state
- Methods of separation

1. Objectives

At least one-half of the items in each of the following categories of objectives are to be selected when planning the teaching of this unit.

Attitudes. Students will be encouraged to develop:

a) curiosity about the properties of some substances used in everyday life (3b, 3c);

b) a respect for accuracy when making measurements (2b);

c) an appreciation of the fact that scientific knowledge has led to the development of the many materials used in our daily lives (3g);

d) a commitment to practise the use of appropriate terminology to communicate their observations accurately (2a).

Skills. Students will have the opportunity to develop skill in:

a) observing the properties of chemicals (2a);
b) measuring mass using a balance (2b);
c) measuring volume using a graduated cylinder (2b);
d) recording their observations in tabular form (2a);
e) classifying substances according to their properties (2a);
f) using a Celsius thermometer (2d);
g) using laboratory equipment for evaporation, filtration, and the heating of liquids and solids (2i);
h) making careful observations and communicating these accurately in oral or written form (2a).

Knowledge. Students will be expected to:

a) correctly use each of the following terms and give an example of each of the following: pure substance, mechanical mixture, solution, solvent, solute, emulsion, suspension (2a);
b) differentiate between the qualitative and quantitative properties of a substance (2a, 2b);
c) list at least four properties of any object that is examined (2a);
d) identify the apparatus used in the laboratory to measure mass, volume, and temperature (2b, 2e);
e) express the correct SI units for measurements of mass, volume, and temperature;

f) give one example to illustrate each of the following terms: miscible, immiscible, soluble, insoluble (2c);

g) name six possible changes of state, identify the heat change involved in each case, and provide an example of each change (2d-2f);

h) state the effect on both the melting and the boiling point of a pure substance when a solute is added to it (2g, 2h);

i) state that less dense objects float on liquids that are more dense and give examples to illustrate this phenomenon (2c);

j) explain that the term dense refers to a comparison of the masses of objects having the same volume (2b);

k) state the property being used when substances are separated by filtration and by evaporation (2i);

l) explain the purpose of filtration, sedimentation, and chlorination in treating drinking water.

2. Student Activities

Students are to:

*a) observe and record the properties of several common substances including examples of a pure solid, pure liquid, gas, mechanical mixture, solution, emulsion, and suspension, and then classify the substances as pure substances, mechanical mixtures, and solutions (5d, 6a, 6b, 8a);

*b) measure the masses of equal volumes of different solids, liquids, and solutions and compare their relative masses by constructing a table that ranks them by mass (5b, 6b, 6g, 8b, 8c);

c) carry out an experiment to compare the solubilities and miscibilities of several common liquids such as water, corn oil, alcohol, and petroleum ether (6b, 6g, 8a, 8d);

d) carry out an experiment to determine the melting point of ice or lauric or stearic acid (6d, 6f, 8e);

e) carry out an experiment to determine the boiling point of water (6d, 6f, 8f);

f) observe and record the changes to dry ice at room temperature;

*g) carry out an experiment to determine the effect on the melting point of ice of adding measured quantities of salt (6d, 8e);

h) carry out an experiment to determine the effects on the boiling point of pure water of adding measured quantities of salt (6d, 6f, 8f);

*i) carry out an experiment to separate the components of a mixture, using techniques such as magnetic separation, flotation, dissolving, filtration, or evaporation (5c, 6b, 8g).

*See the subsection entitled "Student Activities" on page 8.

3. Applications

a) The properties used to classify a substance usually form the basis for the method used to separate its components.

b) Battery-acid testers and the hydrometers used in measuring the amount of antifreeze, milk fat, or brine in a test solution make use of a substance's unique relative density.

c) The solubility of substances in a variety of solvents is employed extensively in cleaning and stain removal as well as in many industrial processes, such as the extraction and blending of essential oils in perfume making.

d) The control of changes of state is used to control the flow of heat in heat pumps and refrigeration units.

e) The technique of lowering the freezing point by adding solutes is employed in the thawing of street ice and in both the cool and hot packs used to treat injuries.

f) Characteristic properties, such as melting point and boiling point, serve as a means of identifying unknown substances and determining the purity of a known substance.

g) Solutes are used to lower freezing points and elevate boiling points. For example, ethylene glycol is added to water in engine cooling systems to avoid freeze-up and boil-over.

h) The separation of substances on the basis of differences in physical properties is applied in many industrial processes from mineral concentration to the refining and purification of petroleum products.

4. Societal Implications

a) Many of the substances listed on product labels are included for a specific property they possess. Some of these chemicals may cause an allergic reaction in certain individuals.

b) Mass is generally a more reliable measure for the consumer to use than volume when comparing the cost of products. It is not influenced by the presence of air spaces, as in granular products, or by the method of packaging used.

c) Water's ability to dissolve substances has been used to remove and dilute many substances that pollute our environment.

d) Large quantities of salt are used to melt ice on city roads. The resulting solution may cause extensive damage to cars and roads. It also enters natural water systems through storm sewers and affects aquatic life.

e) The use of salt in cooking water to control texture and decrease cooking time increases salt intake and poses a problem for those on low-salt diets.

f) The solubility of both harmful and helpful substances in living systems enables them to circulate through some tissue and to concentrate in others. This accounts for the buildup of such toxins as mercury, dioxin, and DDT in fatty tissue.

g) The properties of many harmful chemicals make them difficult to remove in water-treatment plants. As a result a wide variety of devices to remove these chemicals is now available for private use. Consumers should understand the properties of these devices when considering their purhase.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on such activities as students':

a) use of tables in recording data;

b) accurate use of balances, volumetric glassware, and thermometers;

c) ability to separate a simple mixture of solids;

d) ability to make accurate observations and determine properties of an unknown substance.

6. Safety Considerations

a) Students should be cautioned about the possible dangers of tasting unknown substances. The use of taste in testing should be avoided unless specifically requested by the teacher.

b) Some substances may be irritating to various individuals. Students should wash their hands after handling chemicals.

c) The use of methanol as a solvent should be avoided.

d) Thermometers should be secured during use and should not be used to stir liquids. Students should be advised not to heat the bulb directly.

e) Alcohol should not be kept near open flames.

f) Appropriate eyewear should be worn whenever students are heating liquids.

g) Alcohol and petroleum ether should only be used in a well-ventilated area.

7. Possible Extensions

Some students might:

a) expand the classification of matter to include compounds, elements, metals, and non-metals;

b) study the terms relating to solution concentration and construct a simple hydrometer;

c) compare the changes in the properties of matter that occur during chemical changes, changes of state, and other physical changes;

d) examine the effect of antifreeze on the melting point of ice or on the freezing point of water;

e) devise an experiment to determine the purest sample of a substance from samples containing various amounts of an impurity;

f) carry out an experiment illustrating the temperature changes that take place as a sample of ice at -10°C is warmed to room temperature;

g) carry out an experiment to illustrate the separation of inks by means of paper chromatography and relate this to tie-dyeing and the removal of stains from fabrics;

h) investigate various methods available to the consumer for treating water at home.

8. Some Teaching Suggestions

a) Common substances that may be used in various activities should be selected (e.g., ethyl alcohol, food colouring, cooking oil, salt solution, iron, copper, hardwood and balsa wood, styrofoam, water, mothballs, rubber, carbon dioxide).

b) The problems of density calculations can be avoided through the use of solid samples that have a constant volume. Liquid samples having the same volume can also be weighed.

c) A comparison of the experimental masses mentioned in (b) can be used to discuss flotation and the relative mass ranges for solids, liquids, and gases.

d) Small amounts of the substances previously used can be combined in pairs to determine which float, sink, dissolve, or are miscible in each solvent. The properties that could be used to separate the pairs can be discussed.

e) Crushed ice or snow can be used in activities involving the lowering of the melting point of ice. Small plastic ice-cream spoons provide an easy method of measuring the quantities of salt added.

f) Good results for the elevation of the boiling point of water can be obtained by using small flasks containing about 75 mL of water (or solution) with the bulb of the thermometer suspended in the water. The temperature versus time should be graphed every thirty seconds to provide a visual record of the results.

g) A mixture of iron filings, coarse sand, wood chips, and salt provides an easy mixture to investigate. Students can be asked to identify and present samples of the separated substances. As a follow-up the class can discuss the separations required for recycling materials.

h) The following are examples of new topics or units that can be developed from this unit:

Topics in This Unit	Additional Topics or Units
Comparing properties	Chemistry
Solubility	Cleaning substances
Changes of state	Heat and temperature
Methods of separation	Industrial processes Water purification

Science, Grade 9, Basic Level

Optional Unit 4

Water World

Time: About 20 hours

Three-fourths of the earth is covered with water, which is used for drinking, washing, cooking, mixing, mining, and boating. Its presence governs the fate of all life. Unfortunately, water has been taken for granted throughout history. Canada has been endowed with an abundant clean water supply, which needs to be preserved.

In this unit, the students will become acquainted with the properties of water while studying its uses. They will also consider the problem of water pollution and examine some means of rectifying it.

This unit may be divided into topics such as the following:

- Water and living organisms
- The water cycle
- Properties of water
- Water pollution
- Water treatment

1. Objectives

At least one-half of the items in each of the following categories of objectives are to be selected when planning the teaching of this unit.

Attitudes. Students will be encouraged to develop:

a) an appreciation of the importance of water to all living things (2a);

b) a willingness to conserve supplies of pure water;

c) a commitment to help solve the water-pollution problem (3g);

d) curiosity about some of the unique properties of water (2d).

Skills. Students will have the opportunity to develop skill in:

a) observing fruits or vegetables when water is removed from them (2a);

b) predicting the problems that arise when clean water is in limited supply;

c) experimenting to determine some properties of water (2d, 2e);

d) identifying controls and variables in an investigation (2b);

e) observing methods of purifying water (2f, 2g).

Knowledge. Students will be expected to:

a) identify water as the main component of living organisms (2a);

b) explain why it is necessary to consume liquids on a warm day (2a);

c) describe why water condenses on a cold surface (2c);

d) explain how frost forms (2c);

e) describe the main parts of the water cycle (2c);

f) discuss two factors that control the rate of evaporation (2c);

g) name the two elements in the compound "water" (2e);

h) describe three properties of water (2d);

i) state four uses of water (2d);

j) list the main sources of water pollution;

k) describe the relationship between algal growth and phosphate concentration;

l) state problems that hard water causes in industry and the home (2d);

m) describe a method of purifying water (2f);

n) outline the steps in water purification at a typical sewage-treatment plant (2g).

2. Student Activities

Students are to:

*a) compare the amount of water in several fruits and vegetables (8a);

b) carry out an experiment to determine the per cent of water in samples of different soils (6b, 6c);

c) conduct experiments to illustrate phases of the water cycle (6b, 6c, 8b);

*d) demonstrate several physical and chemical properties of water (5c, 6b, 6c, 8d, 8e);

e) carry out an experiment to determine the chemical composition of water (6a-6c, 8c);

*f) perform experiments to determine methods of purifying water (5b, 6b, 6d, 8i);

g) prepare a diagram or a simple model of a modern sewage-treatment plant (8i).

*See the subsection entitled "Student Activities" on page 8.

3. Applications

a) Dehydration is an excellent method of preserving food.

b) The "seeding" of clouds is a method used to induce rain.

c) Humidity and wind speed affect the drying time of wet clothing.

d) The density of ice permits it to float on water. Consequently, aquatic flora and fauna can remain under the ice during the winter.

e) Fields are tilled in such a manner as to minimize water loss.

f) Dew and fog develop when warm, humid air encounters a cold environment.

g) Waste-treatment techniques, such as settling, dilution, and break down by bacteria, are used to purify water in sewage-treatment plants.

4. Societal Implications

a) The availability of water has determined locations for housing developments.

b) Many humans die annually as a result of drought and resulting famine.

c) Rerouting rivers to arid regions has both positive and negative consequences.

d) The control of parts of a river system by one country may affect areas in another country.

e) A large proportion of Canada's electrical energy supply is dependent on water.

f) Acid rain is a major environmental problem in Canada.

g) The number of cottages or resorts erected on a lake is restricted according to the "carrying capacity" of the water.

h) During the summer some beaches are closed because of high coliform counts.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on such activities as students':

a) ability to interpret experimental data;

b) experiments to purify water;

c) observations from experiments on the properties of water.

6. Safety Considerations

a) Appropriate caution should be exercised during the electrolysis of water.

b) Students should wear protective eyewear when heating soil or water.

c) Ring clamps become very hot in a short period of time and should be handled with care.

d) "Dirty water" should be manufactured in the lab. Samples collected from local streams and ponds should not be used.

7. Possible Extensions

Some students might:

a) examine the annual precipitation rates across Canada and compare them with the locations of major populations, of different types of industry, and of different types of agriculture;

b) investigate different methods by which countries obtain fresh water;

c) calculate the per cent of moisture loss from a piece of fresh fruit when it is dehydrated;

d) investigate the properties and manufacturing of dry ice;

e) construct a water clock;

f) investigate the organisms that inhabit local ponds and streams.

8. Some Teaching Suggestions

a) (i) Students can bring in a fruit or vegetable from home and determine, over a period of several days, the change in its mass. (ii) The changes in mass of a plant without any soil can be determined over a period of several days. (iii) A melon or lime can be crushed to show that water is a major component. (iv) The water content of a grape and a raisin or a plum and a prune can be compared. (v) The condition of watered and unwatered plants can be compared.

b) (i) A pan of boiling water and a beaker of ice cubes or a cold pie plate are simple pieces of apparatus that can be used to illustrate the water cycle. (ii) A plant wrapped in an air-tight container can be used to show transpiration. (iii) Evaporation can be demonstrated by leaving a pan of water for a period of time. Daily observations should be made. (iv) A distillation demonstration can be used to illustrate the water cycle. (v) Factors that affect the rate of evaporation, such as temperature, surface area, wind, and the use of a sealed or an open container can be investigated.

c) The composition of water can be investigated by carrying out a simple electrolysis.

d) (i) Cold, dyed water can be added to a jar of warm water to illustrate the relationship of temperature and density. (ii) The sinking and floating qualities of objects can be examined.

e) (i) Factors affecting the boiling and freezing point of water should be discussed in relation to concrete examples (e.g., antifreeze, the alcohol content of homemade wine). (ii) Water pressure may be shown by covering the top of a thistle tube with a membrane. When this apparatus is inserted into a column of water, increased pressure will be noted. (iii) A siphon can be demonstrated and its use discussed. (iv) Saturated and supersaturated solutions can be prepared.

f) Pictures or films depicting the numerous uses of water can be viewed. (ii) Students can be given opportunities to predict the consequences of a disrupted water cycle. (iii) Students can tour an operating power plant to identify the role of water in the production of power.

g) (i) Water consumption in a shower and a bath can be compared. (ii) The volume of water lost from a dripping faucet can be calculated to determine the water wasted per month. (iii) The daily water requirements of the class can be determined and the percentage of "wasted" water calculated.

h) (i) Various fertilizer amounts can be added to containers filled with pond water. The growth of pond scum can be recorded during a one-month period. (ii) The soil run-off from an artificially constructed "stream" can be collected. (iii) Data on the safe level of fish consumption can be examined. (iv) Films that illustrate water pollution can be viewed. (v) Water can be tested for hardness, and its effect on industrial boilers and plumbing can be discussed.

i) (i) A model of a typical sewage-treatment plant can be constructed. (ii) A visit to the local sewage-treatment plant or water-purification plant can add interest to this unit. (iii) The fact that water quality can be improved through sedimentation, coagulation, and filtration should be stressed. (iv) The effect of adding copper sulphate to an algal bloom sample can be studied. (v) An aerated fish tank can be compared to one that is not receiving oxygen. (vi) Water-quality statistics from the past decade can be examined. (vii) A map of the sewage system in the school can be made.

j) The following are examples of new topics or units that can be developed from this unit:

Topics in This Unit	Additional Topics or Units
Water and living organisms	Aquatic ecology Hydroponics Snow ecology Limnology
The water cycle	Weather Climate
Properties of water	Transportation Glaciation
Water pollution	Fertilizers Algae
Water treatment	Drinking water

Science, Grade 9, Basic Level

Optional Unit 5

Science and Sport

Time: About 20 hours

Sports and other physical activities involve the co-ordinated use of muscles and bones. In this unit students investigate through laboratory activities the structure and function of muscles and bones and their relationship to physical fitness. The unit should be planned in co-operation with teachers of physical and health education so that the science and health programs are complementary.

This unit may be divided into topics such as the following:

- Pumping iron: the muscle system
- Bones: the skeletal system
- Staying in shape
- First aid: a physiological approach
- Reaction time
- Stress

1. Objectives

At least one-half of the items in each of the following categories of objectives are to be selected when planning the teaching of this unit.

Attitudes. Students will be encouraged to develop:

a) a respect for proper training procedures and proper diet (3a);

b) a concern for the relationship between stress and mental health (4d);

c) an interest in appropriate activities for various age groups (3d).

Skills. Students will have the opportunity to develop skill in:

a) observing muscle tissue in a preserved specimen (2a);

b) measuring the reaction time of individuals in the class (2f);

c) using a microscope to identify the three muscle types (2a);

d) recording data in chart form (2c, 2d, 2f);

e) determining heart rate, breathing rate, and body temperature (2d).

Knowledge. Students will be expected to:

a) state and identify the location of the various types of muscle, for example, skeletal, smooth, and cardiac (2a);

b) identify a muscle tissue by microscopic examination (2a);

c) state the function of the three muscle types (2a);

d) describe the relationship between the diameter of a bone and the bulk weight it can support (2b);

e) name and locate several of the largest bones of the body (2b);

f) describe the uses of the different types of joints in the human body (2b);

g) state the food groups essential for supplying the muscle with energy and for muscle growth (2c);

h) state the function of ligaments and tendons;

i) describe the physiological benefits of warming up prior to doing a physical activity (2d);

j) describe the biology of various first-aid techniques used to treat sports injuries (2e);

k) describe physical activities that would be ideal for leisure time (2f);

l) list the physiological characteristics of a person under stress;

m) select methods to overcome or reduce stress (2g).

2. Student Activities

Students are to:

a) (i) observe the structure of muscles, ligaments, and tendons in a preserved specimen such as a rat or (ii) observe the three types of muscle tissue under a microscope (6c, 6e, 6g, 8a);

b) investigate the characteristics, including structure, strength, shape, position, and function, of various bones in the body (6c, 6e, 6g, 8b);

*c) (i) test some favourite foods for nutrient content or (ii) analyse their own diet for nutrient content or (iii) design a diet based on accepted dietary requirements for an adolescent (5b, 6g, 8c);

*d) measure changes in the heart rate, breathing rate, and body temperature before and after a standard warm-up procedure for jogging or some other activity (5c, 6a, 6b, 6d, 6f, 8d);

e) discuss the physiological significance of first-aid procedures for injuries such as a punctured lung, a severed artery in the leg, or a broken bone (8e);

f) measure the reaction time of individuals within the class.

*See the subsection entitled "Student Activities" on page 8.

3. Applications

a) Following a proper training program will reduce injuries.

b) First aid is based on an understanding of biological principles.

c) Stress can be reduced by recognizing its symptoms and taking appropriate action.

d) Many natural changes take place in the body as it ages.

e) Many accidents (e.g., strain, sprain) can be avoided by following a warm-up procedure.

4. Societal Implications

a) Strains and sprains cause many work-hours to be lost annually.

b) The average age of Canadians will likely increase significantly by the year 2000. Leisure-time activities will be important for this group.

c) An increase in the number of people knowledgeable in first aid and artificial resuscitation will make help more readily available should a mishap occur.

d) A fast-paced, highly technological society is causing more stress-related illnesses to develop.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on such activities as students':

a) ability to organize results in charts or graphs;

b) ability to determine the nutrient composition of a food;

c) ability to measure changes in heart rate, breathing rate, and body temperature.

6. Safety Considerations

a) Any activities involving heavy lifting should be avoided.

b) A warm-up period should precede any activity involving muscular activity.

c) Students with physical health problems should not participate in physical activities.

d) If dissecting equipment is used, it should be handled with care.

e) Students should wear gloves when handling preserved material.

f) Students should wash their hands after using chemicals or handling preserved specimens.

g) Thermal strips or appropriate sterile thermometers should be used to measure body temperatures.

7. Possible Extensions

Some students might:

a) discuss how muscle shape is related to muscle function;

b) measure the extent of muscle fatigue over time and graph the results;

c) summarize information about world records for running and jumping;

d) survey the level of exercise of people in the classroom;

e) compile a list of strenuous and non-strenuous sports;

f) compare the male and female skeletal systems;

g) grow some brine shrimp or tadpoles to illustrate a natural life cycle.

8. Some Teaching Suggestions

a) (i) Fresh meat or fish can be used to examine muscle tissue and muscle design. (ii) Slides of different muscle tissues can be examined to investigate the relationship of structure to function. (iii) The actions of the biceps and triceps can be compared to reveal how muscles operate antagonistically. (iv) Muscle fatigue of the leg or arm muscles can be investigated. (v) An illustration of muscle groups can be used to locate the actual muscle groups in the body. (vi) The muscle design of a dissected fish can be examined to see how the muscles enable the fish to bend its body. (vii) Various tail-fin shapes can be designed, and their effectiveness in propelling an object through the water tested. (viii) The circumference of the arm can be compared to the weight a person can "curl". (ix) The improvement in Olympic record times over the last few decades can be investigated.

b) (i) The force needed to bend straws of different lengths can be investigated. The principle derived from such findings can be applied to the manipulation of bones. (ii) Cross-sectional bone pieces of a cow femur and a chicken femur can be examined. The structure of the bone can be related to the mass the bone has to support. (iii) Various X-rays of the skeletal system can be examined to investigate bone structure. (iv) A model human skeleton can be examined to investigate the design and position of each group of bones. (v) The operation of a lever can be compared to the function of the arm or leg. (vi) Different types of joints throughout the body can be identified.

c) (i) Students should be encouraged to use joules or kilojoules when referring to units of energy. (ii) Data on the changes in dietary demands as individuals grow older can be studied. (iii) The energy output during various physical activities can be examined, and this information can be used to design a menu for an athletic teenager. (iv) The influence of commercials on eating habits can be investigated.

d) (i) A basic warm-up procedure should be followed before activities designed to produce changes in heart rate, blood pressure, and body temperature are carried out. Reasons for this action should be discussed. (ii) The flexibility of cold muscles and muscles that have been conditioned can be compared.

e) Possible accidents that could occur in the home or workplace or on the sports field can be identified, and the appropriate first-aid techniques discussed.

f) The reaction time of individuals within the class can be investigated using the dropping-metre-stick experiment.

g) (i) The school or board psychologist can be invited to the class to discuss stress and teenage suicide. (ii) Stress situations that have occurred in the classroom during the year can be discussed.

j) The following are examples of new topics or units that can be developed from this unit:

Topics in This Unit	Additional Topics or Units
Pumping iron: muscle system	Weight lifting Microscopy
Bones: the skeletal system	Levers and simple machines Architecture
Staying in shape	Diet Fitness
First aid: a physiological approach	Athletic training
Reaction time	Sports and reaction time Geriatrics
Stress	Mental health The nervous system

Science, Grade 9, Basic Level

Optional Unit 6

Locally Designed Units (LDUs) Time: About 20 hours each

The time remaining after the core unit and at least three of the optional units 1 to 5 have been taught is to be used for locally designed units. These units can be used to introduce a new area or topic of science not described in this guideline or to incorporate additional objectives that will expand a previous part or parts of the course. The following are examples of new areas or topics that might be considered:

- Adaptations of plants and animals
- Agriculture
- Astronomy
- Chemicals
- Cosmetics
- Electricity
- Food science
- Forestry
- Fungi
- Horticulture
- Mining
- Outdoor studies

Such units can provide an excellent opportunity for students to engage in independent individual or small-group study on a topic in science that is of particular interest to them and that is approved, monitored, and evaluated by the teacher. Care should be taken not to allow the work to overlap with subject matter in other science courses that the students are likely to take. Independent study involving laboratory work should be started only after students have had ample experience in the laboratory and are well aware of accident prevention. If a series of short topics is considered, these topics may be fitted into the course schedule from time to time throughout the semester or year.

Science, Grade 9, Basic Level
Optional Unit 6: Locally Designed Units

Locally designed units are to incorporate the following components: objectives, student activities, applications, societal implications, safety considerations. An outline of these units is to be included with the school's course outline and kept on file so that it is available to interested students and parents.

Science, Grade 10, Basic Level (SNC2B)

Core Unit

World Beyond

Optional Units*

1. Fibres and Fabrics
2. Sun, Skin, and Eyes
3. Science and Health
4. Outer Space
5. Science and Food
6. Locally Designed Units (LDUs)

*The optional units selected for the course must include three or more of optional units 1 to 5 and may include LDUs as well.

Science, Grade 10, Basic Level (SNC2B)

Core Unit

World Beyond

Time: Up to 30 hours

The eye is the sense organ used for observing the world around us. Microscopes and telescopes are used to view objects too small or too far away to be seen with the naked eye. Lenses in microscopes and telescopes function in a manner similar to the lens in the eye. In this unit students will have opportunities to compare the lens of the eye, the microscope, and the telescope and to use microscopes or telescopes to examine the world around them.

This unit may be divided into topics such as the following:

- The eye
- Lenses and images
- The microscope
- Protists
- The cell
- Crystals
- The telescope
- Outer space

1. Objectives

At least one-half of the items in each of the following categories of objectives are to be selected when planning the teaching of this unit.

Attitudes. Students will be encouraged to develop:

a) a curiosity about the part of the environment that is too small or too far away to be seen with the naked eye (2d, 2g);

b) an appreciation of the scientific knowledge that has led to the development of scientific instruments (3d, 4a, 4b);

c) an appreciation for the limits of scientific investigation.

Skills. Students will have the opportunity to develop skill in:

a) handling equipment in a safe manner;

b) manipulating and caring for a hand lens, a microscope, or a telescope and observing and recording accurately what they see with the instrument (2d, 2g);

c) manipulating lenses and mirrors to produce simple optical instruments (2b, 2c);

d) observing the structure of the eye (2a);

e) accurately drawing simple ray diagrams to show how images are seen in a microscope, a telescope, and the eye (2a, 2b);

f) preparing slides for viewing with a microscope (2e);

g) using a microscope to view microscopic organisms (2d);

h) using a telescope to view the sky (2g).

Knowledge. Students will be expected to:

a) identify on a diagram or in a dissection the major structures of the eye, including the lens (2a);

b) explain the role of the lens and the cornea of the eye (2a);

c) name and describe three disfunctions of the eye;

d) state that light travels in straight lines from an emitter to a receiver, for example, from an object to the eye (2a, 2b);

e) explain that a light beam is composed of many individual rays that combine to form an image;

f) use diagrams to explain how lenses and mirrors are used in microscopes and telescopes (2b);

g) name and state the function of the parts of a microscope (2d);

h) state the main points of the cell theory (2e);

i) name and state the function of cell structures that are visible with a light microscope (2d, 2e);

j) identify and describe various crystals, such as salt, alum, and copper sulfate (2f);

k) identify four constellations, including the Big Dipper and Little Dipper from a star chart or in the night sky (2g);

l) name the planets that have been investigated by space probes and indicate the type of information obtained;

m) describe some legends of astronomy;

n) describe some potential uses for microscopes or telescopes in the future (2h).

2. Student Activities

Students are to:

*a) dissect the eye of a cow or sheep to observe the main parts of the eye or draw a ray diagram to show the passage of light through the lens in the eye (5a, 5c, 6d, 8a);

b) use a lens to produce an image that is larger than an object and draw a ray diagram to show how the image is produced from the object (8b);

c) construct a simple microscope or telescope using two lenses, a mirror if necessary, and a cardboard tube (5e, 6c, 8f);

*d) demonstrate the correct procedures for viewing with a compound microscope and draw and label diagrams of simple protists, animal cells, plant cells, or crystals as observed with a microscope (5b, 6b, 8c, 8d);

e) prepare microscope slides of onion skin or human cheek cells for observing under the microscope (5d);

f) use a microscope to view the growth of salol crystals (6b, 8h);

g) view the night sky with a telescope, binoculars, or with the eye only and identify objects, using a simple star chart;

h) write about or orally report on at least one of the following: electron microscopes and their uses, the use of the microscope in industry and medical research and practice, the planetary system, constellations, possible life in space.

*See the subsection entitled "Student Activities" on page 8.

3. Applications

a) The microscope is used in many aspects of industrial and medical research.

b) The diagnosis of many diseases and the analysis of blood involve the use of the microscope.

c) The microscope is an important tool in microsurgery.

d) Communication satellites move in orbits around the earth in the same way that planets move in orbits around the sun.

e) Black holes, rocketry, and living in outer space are the topics of many present-day movies.

4. Societal Implications

a) The use of the microscope during surgery has led to new techniques for saving lives.

b) Many disease organisms have been identified by means of the microscope.

c) Large amounts of money are spent to build bigger and more sophisticated telescopes.

d) Contact lenses and eyeglasses have been developed to solve various vision problems.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on such activities as students':

a) drawing of ray diagrams for the eye or an optical instrument;

b) use of the microscope or telescope;

c) dissections of a cow or sheep eye;

d) preparation of whole mounts of animal and plant cells;

e) construction of a simple microscope, telescpe, or other optical device;

f) written or oral assignments on microscopy or astronomy.

6. Safety Considerations

a) Students should exercise care when using equipment such as the compound microscope and the telescope.

b) Students should wash their hands after examining protists and after handling crystals.

c) Students should be cautioned not to look at the sun with the naked eye or with a lens.

d) Students should wear protective gloves and eyewear when performing a dissection.

7. Possible Extensions

Some students might:

a) examine the structure and the function of the eye to explain how we see;

b) invite a lens technician or an optometrist to visit the classroom to tell students about the manufacture of contact lenses and eyeglasses;

c) visit a planetarium or observatory;

d) visit a medical or research laboratory;

e) use an eye chart to check for visual acuity or colour blindness;

f) investigate fibre optics and their applications;

g) investigate the transmission electron microscope - a Canadian invention;

h) investigate the use of the scanning electron microscope.

8. Some Teaching Suggestions

a) A fresh cow or sheep eye can be obtained from a biological supply house or from an abattoir. The dissection should be kept simple, with only scissors and a probe being used. The removal of the lens is possible. Students should be permitted to examine and identify as many parts of the eye as possible.

b) The overhead projector may be employed as an example of the use of a lens and mirror to magnify an object. The discussion related to objects and images should be kept at a simple level.

c) The use and care of the microscope is an important skill, which should be evaluated continuously.

d) Live amoeba and paramecia are best for microscope work because of their size.

e) A large telescope may not be available for use in all schools. Small terrestrial telescopes are available from most suppliers at a nominal cost. It may be possible to share telescopes between schools.

f) A microscope can be constructed by inserting two convex lenses about 6 cm apart into a toilet or paper-towel tube. This microscope can be used for viewing hair, crystals, and skin.

g) Star charts can be obtained from a variety of sources, including science centres, planetariums, and most science stores. Alternatively, students can make a simple chart for their own use.

h) A supersaturated solution of salol or sodium thiosulfate provides an excellent medium for crystal growth.

i) The following are examples of new topics or units that can be developed from this unit:

Topics in This Unit	Additional Topics or Units
The eye	Senses Eyes in other organisms
Lenses and images	Optometry
The microscope	Microbiology
Protists	Pond study
The cell	Tissues and organs
Crystals	Properties of matter
The telescope	Planets
Outer space	Stars and galaxies Rocketry Space travel Satellites

Science, Grade 10, Basic Level

Optional Unit 1

Fibres and Fabrics

Time: About 20 hours

The use of chemicals derived from petroleum to make new synthetic materials has altered society significantly. No longer are natural materials the sole resource for apparel or shelter material. Synthetics have changed what people wear, how clothing is cleaned, and the colours of materials; they have even permitted humans to walk in space. This unit will focus on the role of scientific investigations in determining the properties of fibres and fabrics.

This unit may be divided into topics such as the following:

- Fibre characteristics
- Fibre analysis
- Dyeing
- Making paper
- Spinning glass

1. Objectives

At least one-half of the items in each of the following categories of objectives are to be selected when planning the teaching of this unit.

Attitudes. Students will be encouraged to develop:

a) curiosity about the characteristics of natural and synthetic fibres (2a);

b) a respect for the use of the scientific method to develop synthetic fibres (4c);

c) an interest in the textile industry (3a).

Skills. Students will have the opportunity to develop skill in:

a) observing the properties of materials under the influence of different environments (2c, 2d);
b) tabulating and graphing fibre-analysis data (2c, 2d, 2h);
c) drawing material as viewed under the compound microscope (2b);
d) establishing a control in a scientific investigation (2d, 2f);
e) grouping objects according to their similarities (2a).

Knowledge. Students will be expected to:

a) classify fibres into natural and synthetic materials (2a);
b) explain the relationship of petroleum supplies to the availability of synthetics;
c) identify at least one advantage that a synthetic fibre has over a natural fibre and vice versa (2a, 2c);
d) compare the characteristics of several fabrics (2c, 2d);
e) identify the fibre group that an unknown fibre belongs to (2b);
f) identify two different types of fibres;
g) list the properties that are unique to various fibres;
h) state the uses of various fibres (2a);
i) identify the conditions necessary for dyeing fabrics (2f);
j) list several natural dyes (2f);
k) explain how a mordant (fixative) increases a fabric's affinity for dyes (2f);
l) state the sequence that must be followed in making recycled paper (2g);
m) describe the importance of recycling materials (2g);

n) explain why fibreglass is a good insulator (2h);

o) state three uses of fibre optics (2h);

p) compare heat transfer in various solids (2h).

2. Student Activities

Students are to:

a) (i) determine the advantages and disadvantages of natural and synthetic fibres or (ii) map the regions of Canada where natural fibres might possibly be produced or (iii) identify the uses of fibres and fabrics in the household (8a, 8b);

*b) (i) compare the differences in the structure of fibres by comparing the coarse structure or (ii) draw microscope diagrams of various fibres or (iii) examine an unknown fibre and classify it according to its properties (5a, 5c, 8a);

c) do three of the following: (i) perform an experiment to determine which fibres are flammable, (ii) determine the effect of flame-retardant chemicals on fabrics, (iii) identify which fabric would be ideal for rain apparel, (iv) determine how chemicals will alter a fabric's properties, (v) graph the rate of water absorption for various fabrics (6a, 6c, 6d, 8c);

*d) (i) conduct an experiment to determine the breaking point of a fibre or (ii) prepare a three-ply thread and predict and test its breaking point or (iii) test the stretch and elasticity of several samples, for example, cotton or hair (5b, 8d);

e) (i) determine the effect of temperature or cleaning agents in removing dirt from any given fabric or (ii) identify which fabric is the most wear resistant or (iii) determine the effectiveness of various commercial products in eliminating static electricity (6a, 6b, 6d, 8e);

f) (i) conduct an experiment to determine the conditions necessary for cotton to be dyed or (ii) investigate which fabrics have a natural affinity to dyes or (iii) investigate how a mordant alters a fabric's adhesion to a dye (6b, 6d, 8g);

g) prepare a sample of recycled paper from newsprint and compare the quality of the sample paper to the original material (6d, 8h);

h) determine the relative heat-conduction value of glass, copper wire, nichrome wire, and aluminum wire (6c, 6d, 8i).

*See the subsection entitled "Student Activities" on page 8.

3. Applications

a) The properties of different fabrics determine their applications.

b) Adherence to safe-care symbols on clothing should increase the fabric's lifetime.

c) The properties of fabrics should be considered in the purchase of nightwear and bed linen for small children.

d) The recycling of materials conserves limited natural resources.

e) The availability of raw materials is a factor in determining the sale price of a product.

4. Societal Implications

a) The demand for petroleum-based products illustrates the necessity for continued oil exploration and the need to conserve existing supplies.

b) Several synthetics produce toxic vapours or melt when exposed to high temperatures. These qualities are altering their uses in airplanes, highrise hotels, and clothing.

c) The unique qualities of synthetics are expanding their applications in fashion, recreation, and industry.

d) The recycling of newsprint is an excellent means of preserving our diminishing forest resources.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on such activities as students':

a) observations of the properties of fibres and fabrics;
b) graphing and tabulating of data;
c) drawings illustrating fibre characteristics;
d) following of procedures in an experiment.

6. Safety Considerations

a) The laboratory should be well ventilated when students are working with synthetic fibres that produce noxious vapours.

b) Students should be aware of any safety instructions listed on dye or cleanser packages.

c) Materials that have been heated should be allowed to cool prior to clean-up.

d) Students should wear appropriate eyewear and gloves when working with Bunsen burners or chemicals.

7. Possible Extensions

Some students might:

a) investigate the silkworm's life cycle;

b) determine what qualities are required in fabrics exposed to unique environments (e.g., the deep sea, outer space, a steel mill, a forest fire);

c) identify the best detergent for cleaning particular fabrics;

d) investigate the strength ratings assigned to fish line.

8. Some Teaching Suggestions

a) (i) Fibre and fabric materials can generally be obtained from the family studies department or from a tailoring store. (ii) The importance of strong fibres can be illustrated by discussing examples such as the use of a rope in mountain climbing. (iii) The production of nylon can be demonstrated to the class. (iv) The steps in fibreglassing a rust spot can be illustrated. (v) The coarse structure of fabrics can be compared in terms of initial appearance, feel, stretchability, ease of separation, and uniformity. (vi) Fibre differences can be illustrated through microscope drawings. (vii) The fact that a fabric's composition will determine its strength and overall size can be discussed. (viii) The stretchability of different hair fibres can be compared and related to the age and sex of the person from whom the hair was taken and the colour and condition of the hair.

b) (i) Prepared fibre-identification keys are found in most texts on the textile industry. (ii) Students can burn various fibres and record their findings in a chart. Headings can include: Ease of Burning, Ability to Burn on Their Own, Odour Produced, and Appearance of Residue. (iii) A key can be used to identify the fabric burned. (iv) The length of time it takes various fibres to burn completely can be recorded.

c) (i) Wax or detergent products produce significant changes in the absorbency of water by a fabric. (ii) A bar graph can be prepared to show the absorbency of liquids by different fabrics. (iii) Absorbency can be determined by placing fabric samples over the mouths of separate test tubes and then pouring a known quantity of water on the material. The activity can be repeated after wax or detergent has been added to the fabric. (iv) The ends of different fabric strips can be placed in a petri dish filled with water, and the distance the water travels through the fabric in five-minute periods can be measured.

d) (i) The strength of a fibre can be determined by hanging a fibre from a clamp and adding masses to the lower end until the fibre breaks. (ii) The expansion of the fibre following the addition of each mass can be recorded. (iii) A spring scale can be used to measure the force required to break a fibre. (iv) The limit of stretch of different-coloured elastic bands can be measured and recorded. (v) Identical lengths of fibres can be used to attempt to make the strongest possible "rope".

e) (i) Dirty fabric samples can be washed under various environmental conditions (hot water, bleaching agent, detergent). (ii) The cleansing agent that is the best for various stains, such as grass or lipstick, can be investigated. (iii) Fabric samples can be measured before and after a wash to determine shrinkage. (iv) Durability can be determined by rubbing sandpaper over various fabric pieces.

f) The insulating qualities of a fabric can be investigated by wrapping a thermometer bulb in a fabric and exposing it to a bright light. Temperature changes will indicate the fabric's insulating qualities. This section can be used for introducing the idea of the need for a control.

g) Dyeing a T-shirt or a tie can add interest to this unit.

h) (i) Students can write the instructions for paper making on the paper they have made. (ii) It is interesting to determine the mass of paper consumed by a class in a given period of time.

i) One end of various materials, such as copper, glass, and tin, can be placed in a flame, and the time that the fingers holding the other end of the material take to detect a temperature change can be recorded. A conductometer can also be used.

j) The following are examples of new topics or units that can be developed from this unit:

Topics in This Unit	Additional Topics or Units
Fibre characteristics	Allergies Spinning/weaving Plastics Sound
Fibre analysis	Safety Fashion Consumer testing
Dyeing	Printing
Making paper	Forest management
Spinning glass	Insulation Fibreglass cars and boats Making glass

Science, Grade 10, Basic Level

Optional Unit 2

Sun, Skin, and Eyes

Time: About 20 hours

The wrinkled, weatherbeaten skin of people who work out-of-doors is now becoming the skin type of many middle-aged people who spent summer or winter days basking in the sun in their youth. A suntan appears to be a temporary condition, but the damage is cumulative and can cause cancer as well as prematurely aged skin, skin eruptions, and even blindness. Many protective products are now commercially available to screen or block the sun's damaging ultraviolet rays, but it is necessary to make people aware of the undesirable side effects of the sun. In this unit students will investigate the structure of both the skin and the eye and consider the protective mechanisms that these organs employ. Students will also learn how to screen the sun and how to avoid sunburns and skin cancer.

This unit may be divided into topics such as the following:

- Skin
- Body temperature
- Tanning
- Skin disorders
- The eye

1. Objectives

At least one-half of the items in each of the following categories of objectives are to be selected when planning the teaching of this unit.

Attitudes. Students will be encouraged to develop:

a) a concern for people with skin disorders (4a, 4b);

b) an appreciation of the damage that can be caused to the skin by the sun (4a, 4b);

c) a commitment to improving the quality of life by increased care of the skin and eyes (3b, 3c);

d) critical-mindedness when selecting skin- and eye-care products (3b, 4d).

Skills. Students will have the opportunity to develop skill in:

a) recording and interpreting data on the structure of the skin (2a, 2c);

b) manipulating hand lenses and compound microscopes to examine skin structure (2a, 2c);

c) using a prism to break white light (sunlight) into its component parts (2b);

d) mapping the sweat pores on different skin surfaces (2c);

e) graphing the temperature of the body recorded over a specified time (2e);

f) conducting an experiment or a library research project on at least one aspect of the effects of sun on the skin or eyes (2f-2i).

Knowledge. Students will be expected to:

a) describe the structures of the skin (2a, 2c);

b) state the functions of the skin (2a, 2c);

c) state why the body sweats (2c-2e);

d) contrast antiperspirants and deodorants (2c-2d);

e) outline the types of sun radiation and the effects of the sun's radiation on the skin and eyes (2b, 2h, 2i);

f) list at least three disorders of the skin, their symptoms, and their treatment (2h);

g) recognize the characteristics of sunburn (2i);

h) describe the causes of scarring and wrinkling of the skin (2i);

i) outline the causes of increased pigmentation of the skin (2a);

j) explain how to care for sunburns (2i);

k) contrast sun-protection products and sunburn products (2g);

l) explain the need for, and the proper use of, skin-care and sunburn products (2g);

m) outline the proper procedures for healthy skin care;

n) state the function of the eyelid, iris, and pupil (2j);

o) recognize the limitations of sunglasses (2k).

2. Student Activities

Students are to:

a) examine a prepared slide of a cross section of skin with a compound microscope and locate the epidermis, the dermis, a a sweat gland, a sweat pore, and a hair follicle with its associated sebaceous gland (6c);

b) use a prism to break white light up into its spectrum (6e, 8d);

*c) prepare a map of sweat pores on two different skin surfaces of the body (5a, 6a, 6d, 8b);

d) conduct an experiment to estimate the amount of sweat produced while the body is at rest and after exercise (6g, 8c);

*e) record and graph body temperature over a period of twenty minutes before, at least twice during, and after exercise (5b, 6b, 6g);

f) conduct an experiment to compare the protective nature of antiperspirants and deodorants (8e);

g) compare the protective nature of sunscreen, suntan, or sun-block products using a "sun protection factor" chart (6f, 8a, 8f, 8g, 8m);

h) prepare a report on the three types of skin cancer and their causes (8h, 8m);

i) prepare a report on a variety of first-aid treatments for varying degrees of sunburn (8j, 8m);

j) examine the external features of the eye, locating the cornea, pupil, iris, sclerotic coat, and eyelid;

k) conduct an experiment to compare the filtering ability of different sunglasses (6e, 8e).

*See the subsection entitled "Student Activities" on page 8.

3. Applications

a) Careers are available for students interested in cosmetics and dermatology.

b) Sun blocks and sunscreens are available at local drug stores.

c) Many products are available to prevent overexposure to the sun (e.g., headgear, sunglasses, umbrellas).

d) A knowledge of first aid related to the skin is important for all students.

e) Most people are exposed to the sun and the effects of its rays; an understanding of the dangers associated with tanning may lead to better skin protection.

4. Societal Implications

a) Ultraviolet radiation from the sun or other sources (such as lamps) is the leading cause of skin cancer in people. Skin cancer is the most common form of cancer.

b) The premature ageing of the skin by tanning may lead to skin rashes or eruptions of the skin as well as blindness and cancer.

c) Special precautions against overexposure to the sun and high temperatures must be taken by the elderly, the obese, people with diabetes, and those with heart disease.

d) All ultraviolet radiation devices must be government-approved and labelled with warnings.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on such activities as students':

a) preparing maps of sweat pores;

b) recording and graphing body-temperature changes;

c) completing surveys or research assignments on suntanning.

6. Safety Considerations

a) Only a dilute solution of iodine should be used in the preparation of a map of sweat pores. The skin should be washed thoroughly to remove the iodine.

b) Sterilized non-mercury thermometers or thermal strips should be used to measure body temperature.

c) Students should exercise care when using equipment such as the compound microscope.

d) Iodine crystals should not be handled.

e) Students should be cautioned not to look directly at the sun.

f) Unprotected skin should not be exposed to the sun's rays for long periods of time.

g) Students with medical problems should not participate in any activity requiring strenuous physical activity.

h) Students should not mimic a doctor's practice of shining a light directly into another student's eye.

7. Possible Extensions

Some students might:

a) examine the structure of fingernails, scars, and hair;

b) prepare fingerprints of students;

c) prepare a map of the sensory nerves of the skin surface;

d) investigate the effect of rinsing, bleaching, and perming on hair;

e) compare hair shampoos and conditioners.

8. Some Teaching Suggestions

a) A drug-store survey is a good method of collecting and organizing data on sun-care products.

b) Starch and iodine can be used to map sweat pores. The area to be tested should be painted with a 0.01 mol/L solution of iodine. The painted area can then be dusted with starch. Small blue dots indicate the sweat pores. An alternative method is to use cobalt chloride paper. The paper will turn blue when exposed to water.

c) The amount of sweat produced by the skin may be estimated by placing a finger in a test tube. Adhesive tape can be used to seal the tube around the finger. The amount of sweat collected after thirty minutes of quiet activity and ten minutes of strenuous physical activity can be observed.

d) The concept that the sun's rays are made up of more than one wavelength can be shown by using a prism to break white light up into its spectrum.

e) Antiperspirants interfere with the body's ability to sweat. The significance of this interference to the body's heat regulatory mechanism and the viability of using a deodorant instead of an antiperspirant can be discussed.

f) Consumer magazines are a good resource for information on tanning oils, sun blocks, and sunscreens. Paraminobenzoic acid (PABA) should be mentioned as one basis for many sunscreens. Sunglasses should filter out at least 16-29 per cent of the sun's rays to be considered effective.

g) Students should be informed that sunscreens are rated by a scale called the sun-protection factor. It runs from 1 to 15, 15 being the factor offering complete protection from the sun.

h) There are three main types of skin cancer. They are all treatable if sufficient time is available. Melanoma is about 45 per cent fatal. Two per cent of all skin cancers are fatal. Students could find more information from the library resource centre.

i) Ultraviolet light is responsible for tanning and also causes sunburn. Tanning is a biochemical darkening of the existing melanin pigment in the skin. The melanin absorbs, blocks, and scatters ultraviolet light and thus helps to protect the underlying layers of the skin. Students' experiences with sunburn and its effects might form a topic for discussion to initiate this unit.

j) Sunburn can occur at any time of the year. Light reflected off water, sand, or snow can cause sunburn. A visit to a burn unit at a local hospital or a doctor's visit to the school can add interest to this unit.

k) Certain drugs combined with the sun's radiation can induce photosensitive or phototoxic effects. Some classes of these drugs are tetracycline antibiotics, sulfa drugs, oral diabetic drugs, quinidine, some tranquillizers, anti-emetics, anti-hypertensives, and diuretics. Physicians or pharmacists will be able to provide lists of common drugs. Students should be warned about taking these drugs in conbination with sunbathing.

l) A simple way to illustrate the iris response to light is to have pairs of students watch each other's irises as the room lights are turned on.

m) The teacher-librarian can help students find magazine articles and information-file clippings on suntanning, skin cancer, and other skin diseases and drugs.

n) The following are examples of new topics or units that can be developed from this unit:

Topics in This Unit	Additional Topics or Units
Skin	Hairdressing Forensic science Heredity
Body temperature	Outdoor studies
Tanning	Cosmetology
Skin disorders	Illness and disease First aid
The eye	Photography

Science, Grade 10, Basic Level

Optional Unit 3

Science and Health

Time: About 20 hours

Health can be described as a state of physical, mental, and social well-being. Science plays an important role in the study of human health. It not only provides information on the history, causes, and transfer of a disease but has also developed many controls and cures. In this unit students will learn about different types of diseases and the role that science has played in their control and prevention. The student activities are a focus of this unit and provide students with opportunities to investigate experimentally some of the factors that can affect their health.

This unit may be divided into topics such as the following:

- Types of diseases
- The respiratory system
- The circulatory system
- The digestive system
- Effects of caffeine and tobacco
- Disorders of the skin

1. Objectives

At least one-half of the items in each of the following categories of objectives are to be selected when planning the teaching of this unit.

Attitudes: Students will be encouraged to develop:

a) a questioning attitude towards the causes and transmission of diseases (3b);

b) a commitment to improving the quality of life by increasing their awareness of disease prevention (3a, 3c, 4b);

c) an appreciation for the limits of scientific research and development in solving current health problems (4a);

d) a concern for those in society who do not live healthy lives (3c).

Skills. Students will have the opportunity to develop skill in:

a) manipulating a microscope in order to view prepared slides (2a);

b) manipulating or demonstrating the use of a stethoscope or a sphygmomanometer (2c);

c) accurately following a set of written or oral instructions;

d) retrieving information from library resource materials, such as encyclopedias, journals, magazines, and reference books (2h);

e) organizing data in a clear and logical format.

Knowledge. Students will be expected to:

a) list several diseases and give the cause of each (2h);

b) define or correctly use the following terms: disease, infection, contagious, deficiency, allergic, hereditary, degenerative;

c) identify and discuss at least two diseases of the respiratory system, the circulatory system, the digestive system, and the skin (2a);

d) compare and contrast conditions in sanitary and unsanitary places and describe how a healthy environment can be maintained (2h);

e) identify common methods for the prevention of disease (2h).

2. Student Activities

Students are to:

*a) examine prepared microscope slides of lung tissue, cancer tissue, human stomach tissue, ulcerated stomach tissue, and the skin (5a, 6c);

b) perform an experiment that will investigate (i) the destructive distillation products of a cigarette or (ii) the gases inhaled when a cigarette is smoked or (iii) the effects of inhaling tobacco smoke on the human heart rate, blood pressure, and respiration rate (6a-6c, 8c);

*c) perform an experiment to investigate the effect of consuming caffeine, from coffee or tea, on the human heart rate, blood pressure, and respiration rate (5a, 6c, 8c);

*d) prepare a report on common diseases and disorders of the respiratory and circulatory systems, such as asthma, bronchitis, emphysema, influenza, pneumonia, arteriosclerosis, coronary artery disease, and stroke (8d, 8e);

e) perform an experiment to investigate the effectiveness of antacid tablets;

f) prepare a report on common diseases and disorders of the digestive system, such as constipation, diarrhoea, and food poisoning (8d, 8e);

g) prepare a report on (i) common diseases and disorders of the skin, such as acne, eczema, and psoriasis or (ii) local health regulations governing restaurants, garbage and its disposal, dairies, or food processors;

h) conduct a library search and write a report on a way in which science and technology have reduced the effects of disease, aided diagnosis, or speeded up recovery (e.g., pasteurization, inoculations, CAT-scans (computer-assisted tomography), X-rays, casts, orthopedic braces).

*See the subsection entitled "Student Activities" on page 8.

3. Applications

a) Diseases such as poliomyelitis, diptheria, and tetanus are now controlled by programs of inoculation.

b) Modern sanitation and hygiene methods have reduced the outbreaks of diseases such as salmonella, yellow fever, and tetanus.

c) Non-smoking programs have enlightened people about the hazards of tobacco.

d) Sports medicine has become a recognized branch of the medical profession.

e) Medical research into environmental hazards may alleviate some health problems.

f) First-aid and paramedic training programs are offered by many communities in this province.

g) An increasing number of people participate in exercise and health programs.

4. Societal Implications

a) The benefits of controlling malaria by the spraying of infected areas with insecticides must be weighed against the overall effects of these insecticides on the environment.

b) The use of penicillin, insulin, and other drugs has controlled many diseases.

c) Advances in the manufacture of artificial limbs and organs have improved the quality of life of many people who would otherwise be handicapped.

d) Herbal cures and holistic medicine have an appreciable number of followers.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on such activities as students':

a) care and use of laboratory equipment (e.g., microscope, stethoscope, sphygmomanometer);

b) recording and organizing of data;

c) oral or written reports;

d) care and effort in participating in practical work.

6. Safety Considerations

a) Students should be cautioned about the use of open flames. Loose garments should be secured, long hair should be tied back, and the proper fire-safety equipment should be readily available.

b) Students should be warned to remove the end of the condenser from the cool distillate before removing the heat source from the flask, as the distillate could be drawn up and could crack the hot flask.

c) Full instructions should be given for the proper use of equipment such as the microscope, stethoscope, and sphygmomanometer.

7. Possible Extensions

Some students might:

a) invite doctors or nurses into the classroom to discuss diseases and disorders of the body;

b) investigate burn treatment and the types and categories of burns to the body;

c) investigate ageing and the care of the aged;

d) investigate the symptoms of cancer in different parts of the body;

e) determine the nature of an epidemic;

f) explain the function of vitamins in a healthy body.

8. Some Teaching Suggestions

a) A list can be made of illnesses that students have had or know about. These can be classified as allergic, degenerative, hereditary, infectious, or deficiency types of problems.

b) Many resources related to this unit are available from the public health department, libraries, or charitable organizations associated with specific diseases, such as the Muscular Dystrophy Association.

c) The school nurse or public health department may be able to assist in or loan equipment for temperature taking, blood-pressure measurement, and lung-capacity determination. Note: Student activity 2(b) is not mandatory and should not be performed unless students who smoke volunteer freely to undergo testing in the investigation.

d) It may be necessary to review or briefly explain the structure and function of each of the body systems. This can be accomplished by means of diagrams and photographs.

e) Common disorders of the skin include acne, eczema, hypothermia, psoriasis, seborrhea, boils, herpes, warts, athlete's foot, ringworm, and skin cancers. Common disorders of the respiratory tract include the common cold, influenza, pneumonia, tuberculosis, emphysema, pleurisy, bronchitis, asthma, lung cancer, and poliomyelitis. Common disorders of the circulatory system include hypertension, artherosclerosis, varicose veins, rheumatic fever, and stroke; blood disorders include hepatitis, leukemia, and mononucleosis.

f) The following are examples of new topics or units that can be developed from this unit:

Topics in This Unit	Additional Topics or Units
Types of diseases	Pollution
The respiratory system	Fitness and health
The circulatory system	Aerobics
The digestive system	Nutrition
Effects of caffeine and tobacco	Chemicals and drugs
Disorders of the skin	Cosmetics

Science, Grade 10, Basic Level

Optional Unit 4

Outer Space

Time: About 20 hours

Each manned space flight generates a large amount of interest and awe. It stands as a symbol of human ability to overcome the unknown and to adapt to difficult conditions. The knowledge and the technology has developed rapidly in response to the demands of space flight. At the same time critics point out the expense of such ventures and question their value. In this unit students will be introduced to some of the scientific knowledge that has made these feats possible, much of which has been learned from the experiences themselves. Questions will be raised concerning the value, cost, and future of space exploration.

This unit may be divided into topics such as the following:

- Rocket fuels
- Action and reaction
- Orbital flight
- Air pressure
- Motion of the moon
- Trip to the moon

1. Objectives

At least one-half of the items in each of the following categories of objectives are to be selected when planning the teaching of this unit.

Attitudes. Students will be encouraged to develop:

a) curiosity in investigating new ideas (4a, 4b);

b) an appreciation for the direct and indirect benefits that result from investing in research and development (3e, 4b-4d);

c) interest in the role played by science in developing technology and in the way technology often leads to further advances in science (3b, 4b);

d) a respect for the interdependence of living things and their environment (3i).

Skills. Students will have the opportunity to develop skill in:

a) using laboratory equipment to prepare a gas (2a);

b) measuring forces in a vertical or horizontal plane (2b);

c) predicting the moon's phase on the basis of its position relative to the sun and earth (2f);

d) predicting the change in velocity of a spacecraft on the basis of its location and distance from the earth and the moon (2g);

e) investigating and organizing material as part of a small group;

f) designing a model for a successful space colony (2h).

Knowledge. Students will be expected to:

a) state one method used to produce hydrogen gas or to produce oxygen gas (2a);

b) list three properties of hydrogen gas or oxygen gas (2a);

c) use simple examples to explain the concepts of balanced forces and action-reaction forces (2b, 2c);

d) explain the meaning of the following terms: gravity, g-forces, inertia, and mass (2b, 2c);

e) state two advantages that the shuttle has over earlier spacecraft (2d);

f) explain the cause of air pressure and describe an experiment to demonstrate its existence (2e);

g) state the meaning of the following terms: rotation, revolution, moon phase (2g);

h) explain the causes of night and day and the phases of the moon (2g);

i) state the periods of rotation for the earth and the moon and the period for one revolution of the earth by the moon (2g);

j) explain the term escape velocity and the role of gravity and inertia in a flight to the moon and back (2g);

k) compare conditions such as gravity, atmosphere, food chains, and solar radiation on the surfaces of the earth and the moon (2h);

l) list the materials that are necessary to support life in space (2e, 2h).

2. Student Activities

Students are to:

*a) carry out an experiment to prepare hydrogen or oxygen gas and to study its properties (5a, 6a-6f, 8b);

*b) (i) carry out experiments using such items as a dynamics cart, a spring balance, and masses to investigate the interrelationship of mass and force in a horizontal plane or (ii) carry out experiments using masses and a newton spring scale to investigate the interrelationship of mass and force in the vertical plane;

c) observe the operation of amusement-park rides such as roller coasters and discuss the forces in effect and the sensations involved (8a, 8c, 8d);

d) find information on the adaptations that are required for life aboard a spacecraft and for extravehicular work (8e);

e) conduct experiments that demonstrate the effects of changes in air pressure, such as the reduction of the boiling point of water and the collapsing of a tin can (6f);

f) (i) examine models of the earth and moon to investigate the rotation of the earth and the revolution of the moon or (ii) use binoculars or a telescope during the day or night to observe the moon and record its surface features;

g) (i) give a written or oral report on the changes brought about by the movements of the moon, such as eclipses, moon phases, and tides or (ii) using library reference materials, find information about a component of a moon flight (e.g., escape velocity, flight path, the vehicle, gravity, propulsion) and summarize their findings (8f-8h);

*h) investigate the conditions required for the establishment of a lunar colony or space station by setting up a self-contained mini-ecosystem in a bottle or by reading a science-fiction story based on life in a space colony (5c, 8i).

*See the subsection entitled "Student Activities" on page 8.

3. Applications

a) Hydrogen is readily produced from water to provide a clean-burning, efficient fuel.

b) Newton's third law is used to help identify forces that cause the movements of objects on earth and in space.

c) The sensations experienced during amusement-park rides and astronauts' training sessions are similar to those experienced during flight. These effects often have an adverse effect on performance.

d) The gravitational forces of heavenly bodies are used to maintain the orbital paths of space vehicles and account for the orbits of natural space objects such as comets and planets.

e) The shuttle and equipment used for extra-vehicular activities permit the recovery and repair of satellites and can be used in the construction of larger orbiting structures.

f) Air pressure affects the properties of many substances, especially fluids, and is required for breathing. The lack of air pressure in space influences the structure of a spacecraft and the activities that can be carried out.

g) The orientation of a satellite with respect to the sun influences and is used to control its temperature.

h) The principles of balanced ecosystems must be duplicated in space stations and colonies to conserve and recycle materials needed for human life.

4. Societal Implications

a) The burning of hydrogen produces only water. This provides a potential means of reducing air pollution caused by combustion.

b) The development of materials and technology for use in space has provided society with new technologies and materials (e.g., the micro-electronics industry).

c) Medical experiments have increased our understanding of many areas, such as motion sickness, balance, and the effects of limited oxygen on perception.

d) The scientific and technological advances of the space industry have led to the growth and development of many industries that provide jobs for technically trained people.

e) The interest in achievements in space provides a focus for the entertainment industry and for science fiction.

f) The lack of air pressure, reduced friction, and gravity in space provide the potential for the more efficient production of materials (e.g., crystals).

g) Satellites are used to provide improved communications, weather forecasting, and mapping.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on such activities as students':

a) producing and testing of hydrogen or oxygen gas;

b) care and effort in following instructions, working safely, and completing tasks;

c) design and preparation of a closed ecosystem;

d) accurate recording and communication of the results of investigations.

6. Safety Considerations

a) Students should wear eye protection when producing and testing hydrogen or oxygen gases. Open flames should not be placed near the generators.

b) The hydrogen or oxygen generator should be clamped to avoid being accidentally overturned.

c) Acid should be added a little at a time during the generating of hydrogen, since the reaction with zinc is exothermic and may go out of control if excess acid is used.

d) Caution must be used in demonstrating the combustion of hydrogen-oxygen mixtures.

e) If hydrogen is prepared by electrolysis, the electrical source should be restricted to six volts, and students should be cautioned regarding the corrosive nature of the electrolyte if an acid is used. Gases from both electrodes should not be collected in a single tube.

f) Caution should be exercised in demonstrating the boiling of water under reduced pressure. Glass containers should not be used.

7. Possible Extensions

Some students might:

a) investigate the forces involved in walking, using the concept of balanced and unbalanced forces, and compare these to those required for movement in space;

b) investigate the safety devices used on roller coasters and other rides;

c) examine re-entry phenomena and the precautions taken at lift-off to ensure the safe return of suborbital components of an unsuccessful launch;

d) study the adaptations for eating aboard the shuttle or prepare a simulated space meal using dehydrated camping foods;

e) compare the operation of a vacuum cleaner on earth and in space and demonstrate the effects of a near vacuum on marshmallows, shaving foam, and popcorn;

f) study the formation of lunar and solar eclipses and investigate the folklore associated with them;

g) investigate some of the experiments set up on the moon or use a lunar map to study its surface and locate the landing sites of the various missions;

h) play a "survival game" in which players rank a list of about twenty items according to their survival value for an individual stranded on the surface of the moon.

8. Some Teaching Suggestions

a) A variety of audio-visual materials, posters, pictures, articles, and models should be used throughout the unit. Students should be encouraged to contribute these resources wherever possible.

b) The preparation of hydrogen by electrolysis also yields oxygen, which is used in rockets. This presents an opportunity to discuss the reverse reaction, which is used in fuel cells to produce electricity and water.

c) Students should be encouraged to bring in pictures of popular rides, which can be used along with articles from science magazines as a basis for discussing the sensations and forces involved.

d) An understanding of centripetal force is not required in this unit, but a demonstration of its principles can simulate the velocity changes required for changing orbits.

e) Groups of students can search for and present information on different aspects of a shuttle mission, such as exercise, eating, washing, or the roles of the crew (e.g., the pilot or mission specialists).

f) An almanac, tide tables, or a calendar can be used to introduce moon phases and lunar motions.

g) The umbra and penumbra of a solar eclipse can be simulated by placing an overhead projector close to the screen with an opaque disc on the stage.

h) The capture of a spacecraft by gravity can be simulated by placing a strong magnet on an opaque disc on an overhead projector and rolling ball bearings past the disc at different speeds and distances.

i) A mini-ecosystem, consisting of a sealed container of water, a few water plants, a small fish, and some snails, can serve as a model for, and the basis of a discussion on the requirements of, a self-contained lunar colony. The system should be set up before the unit is introduced.

j) The following are examples of new topics or units that can be developed from this unit:

Topics in This Unit	Additional Topics or Units
Rocket fuels	Model rocketry Fuels
Action and reaction	Simple machines Energy conservation
Orbital flight	Airplanes Satellites
Air pressure	Siphons and pumps High pressure and low pressure Space medicine
Motion of the moon	Measuring time Seasons History of the solar system
Trip to the moon	Science fiction Space probes and vehicles Resources in space

Science, Grade 10, Basic Level

Optional Unit 5

Science and Food

Time: About 20 hours

A well-balanced diet and an exercise program are essential to good health. A poor diet or overindulgence can lead to illnesses and lifestyle problems. This unit will focus on the need for proper eating habits and look at the way in which the body digests and absorbs the necessary nutrients. The unit should be planned in co-operation with teachers of family studies and physical and health education so that the various subject programs are complementary.

This unit may be divided into topics such as the following:

- Nutrients
- Diet deficiencies
- Digestion and absorption
- Special foods

1. Objectives

At least one-half of the items in each of the following categories of objectives are to be selected when planning the teaching of this unit.

Attitudes. Students will be encouraged to develop:

a) an appreciation of the need for a proper diet and exercise program (3a, 3b, 3d, 4a, 4c);

b) concern for the nutritional needs of people in underdeveloped countries (4b);

c) a willingness to consider scientific findings (4d);

d) a willingness to try different foods (3c-3e).

Skills. Students will have the opportunity to develop skill in:

a) conducting experiments to test for food nutrients (2a);
b) recording findings in a chart (2f);
c) retrieving information from a resource text (2h);
d) observing the movement of materials across a dialysis membrane (2c);
e) observing the action of some chemicals on food (2b).

Knowledge. Students will be expected to:

a) list the major groups of nutrients (2a);
b) describe at least two experiments used to identify the nutrients in a food sample (2a);
c) state the four main food groups (2f);
d) explain why nutrients are important to an organism;
e) describe an organism's need for water;
f) describe a medical problem arising from a vitamin or mineral deficiency;
g) identify several foods that abound in nutrients (2f);
h) describe a well-planned daily menu;
i) identify the cell's main source of energy (2d, 2e);
j) explain the cell's need for energy;
k) determine the total energy value for a given menu;
l) identify carbon dioxide as a waste product of cellular metabolism (2e);
m) describe the nutrients digested in the mouth and stomach (2a);
n) explain why food must be digested before the cell can use it (2c);
o) explain the benefit of dehydrated food in space and on backpacking trips (2h);

p) identify at what point in the digestive tract food is absorbed;

q) explain why people who have had their gall bladder removed must cut down their intake of fatty foods.

2. Student Activities

Students are to:

*a) perform experiments to test for nutrients such as starch, sugar, protein, minerals (sodium), fats, vitamins (vitamin C), and water (6d-6f, 8a, 8b);

b) perform an experiment to determine (i) the end product of starch digestion by the enzymes in the saliva or (ii) the action of pepsin and hydrochloric acid on protein or (iii) the action of rennin in milk or (iv) the action of bile on lipids (6d-6g, 8a-8c);

*c) use dialysis tubing to demonstrate (i) the movement of salt across a cell membrane or (ii) that macromolecules such as sucrose and starch cannot move across the cell membrane, whereas simple molecules like glucose can (6d, 8c);

d) compare the relative amount of stored energy in foods such as sugars and lipids (6c, 6d, 8i);

e) experiment to show that exhaled air contains carbon dioxide (8d);

f) (i) test some favourite foods to determine which nutrients are present or (ii) gather information on the four food groups and design a well-balanced diet or (iii) organize a chart showing the energy value of their favourite foods (6d, 8a, 8b, 8f);

g) test freshly prepared orange juice and orange juice that is twenty-four hours old for vitamin C content (6d, 6f, 8e);

h) (i) visit the library and write a report on one of the following: appendicitis, gallstones, diabetes, causes and symptoms of malnutrition, rickets, scurvy, botulism or (ii) compare dehydrated food such as egg or hamburger with fresh food with respect to taste, ease of use, cost, practicality on space flights and on backpacking trips, and nutritional content (8j).

*See the subsection entitled "Student Activities" on page 8.

3. Applications

a) Most cereal boxes list their nutritional content.

b) Proper exercise and diet are important for good health.

c) Dehydrated "space" food is used by campers.

d) Health-food stores and exercise studios are a commercial response to consumers' desires to improve their personal health and appearance.

4. Societal Implications

a) More people are attempting to stay or become fit. This tends to reduce health-care expenses.

b) Much of Canada's foreign aid is in the form of food stuffs.

c) Fitness and work efficiency go together. Consequently, some industries are constructing gyms and athletic courts for their employees.

d) Anorexia nervosa is a serious teenage problem. The obvious symptom is lack of proper nutrition, but the root causes are complex.

5. Evaluation of Student Achievement

At least 50 per cent of the term mark for this unit is to be based on such activities as students':

a) oral communication with the teacher and other students;

b) experiments and reports of activities;

c) work in a group setting;

d) diagrams and charts of the information collected in the activities.

6. Safety Considerations

a) Students should never consume a liquid or any other substance in the laboratory without explicit permission from the teacher. Food used in experiments should not be consumed in the laboratory.

b) If concentrated sulphuric acid is added to sucrose, it should be done as a teacher demonstration.

c) Students should wear protective gloves and appropriate eyewear when working with chemicals.

d) Students should wash their hands at the end of any activity during which they were handling chemicals.

e) Millon's reagent contains mercury. Students should observe appropriate caution when working with this chemical.

f) When heating small quantities of liquid in a test tube, students should be cautioned (i) to hold the tube at a 45° angle, (ii) to heat the tube evenly, and (iii) to always point the tube away from themselves and other students.

7. Possible Extensions

Some students might:

a) determine the quantity of "good food" tossed out during one lunch period;

b) identify the main ingredients in some canned goods;

c) determine the nutritional value of the food they consume in a one-week period;

d) compare their daily diet to a recommended diet;

e) determine the effects of cooking on the nutritional value of vegetables;

f) determine the relationship between metabolic activity and the amount of required energy.

8. Some Teaching Suggestions

a) The following tests are easy to use and give good results: (i) Iodine or Lugol's solution turns black or dark blue in the presence of starch. (ii) Benedict's reagent turns from green to brick orange in the presence of glucose. (iii) Millon's reagent gives a red precipitate in the presence of some proteins. (iv) Indolphenol is colourless in the presence of vitamin C.

b) Nutrient tests work best if the standards and the foods tested are either in solution or in a watery suspension. The six essential nutrients can be identified by simple experiments.

c) The process of digestion within the digestive tract may be illustrated by the following series of investigations: the action of enzyme amylase on a cracker (sugar-free crackers should be used), the action of hydrochloric acid and pepsin on egg white, and the action of bile on oil. The inability of large macromolecules like sucrose and starch, and by contrast the ability of small molecules like salt and glucose, to pass across the dialysis tubing illustrate the importance of the digestive process to the cells.

d) The carbon dioxide in exhaled air results from the breakdown of glucose in the cells. The exhaled air turns limewater milky, which is a positive test for carbon dioxide. Test tape, which may be used for determining glucose levels, can be purchased from a drug store or a biological supply house. The tape works in the same way as litmus paper. Concentration is determined by a comparison to a standard colour scale that accompanies each package.

e) Improper storage or cooking of food can result in the loss of essential vitamins. For example, vitamin C is oxidized in orange juice that is left standing for twenty-four hours.

f) The Canada Food Guide is an excellent resource, listing the nutrients in foods. Dietary charts can be produced for the class. Students can complete one chart each day. The labels on numerous food products can be examined to determine which nutrients they contain. A nutritionist or the school nurse can be invited to visit the class and discuss nutritional requirements.

g) (i) A local supermarket can be visited and the purchase of a student's food supply for a typical week simulated. The purchases can be classified into their food groups and the results discussed. (ii) Students can record the items they eat during a week and compare their diets to a recommended diet plan. (iii) The menus in the school cafeteria can be examined in terms of a balanced diet.

h) (i) Films depicting the problems of malnutrition can be viewed. (ii) Reports on vitamin and mineral deficiencies can be examined.

i) (i) The addition of concentrated sulphuric acid to sucrose will reveal the potential energy in sugar. (ii) A sample of a food such as a peanut can be burned to estimate its potential energy.

j) The method by which food is prepared in a spacecraft can be examined. A report can be prepared on the effect of gravity on cooking.

j) The following are examples of new topics or units that can be developed from this unit:

Topics in This Unit	Additional Topics or Units
Nutrients	Food production Farming
Diet deficiencies	Food problems of developing countries
Digestion and absorption	Circulation Energy in the ecosystem
Special foods	Food preparation Life in outer space

Science, Grade 10, Basic Level

Optional Unit 6

Locally Designed Units (LDUs) Time: About 20 hours

This unit is the same for the Grade 10 basic-level science course as optional unit 6, "Locally Designed Unit", is for the Grade 9 basic-level course. A different set of topics from those selected in a previous grade should, of course, be chosen for this course.

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Appendixes

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Acknowledgements

Appendix B: Science Courses and Their Course Codes

The secondary school guideline courses in science authorized under this document have the following course codes:

Science, Grade 9, Basic Level	SNC1B
Science, Grade 9, General Level	SNC1G
Science, Grade 9, Advanced Level	SNC1A
Science, Grade 10, Basic Level	SNC2B
Environmental Science, Grade 10, General Level	SEN2G
Science, Grade 10, General Level	SNC2G
Environmental Science, Grade 10, Advanced Level	SEN2A
Science, Grade 10, Advanced Level	SNC2A
Science, Grade 11, Basic Level	SNC3B
Applied Biology, Grade 11, General Level	SBA3G
Applied Chemistry, Grade 11, General Level	SCA3G
Environmental Science, Grade 11, General Level	SEN3G
Biology, Grade 11, Advanced Level	SBI3A
Chemistry, Grade 11, Advanced Level	SCH3A
Science, Grade 12, Basic Level	SNC4B
Applied Physics, Grade 12, General Level	SPA4G
Environmental Science, Grade 12, General Level	SEN4G
Technological Science, Grade 12, General Level	STE4G
Environmental Science, Grade 12, Advanced Level	SEN4A
Geology, Grade 12, Advanced Level	SGE4A
Physics, Grade 12, Advanced Level	SPH4A

Appendix B: Science Courses and Their Course Codes

Biology, OAC	SBIOA
Chemistry, OAC	SCHOA
Physics, OAC	SPHOA
Science in Society, OAC	SSOOA

The following general rules govern science course codes:

- All science course codes begin with an S.
- SNC identifies a course that has only the name *Science*.
- Where one word other than *Science* describes the course, the first two letters of that word follow the S (e.g., SBI means "*S*cience, *Bi*ology" or simply "Biology"; SEN means "*S*cience, *En*vironmental" or "Environmental Science").
- Where two words other than *Science* describe the course, the initial letters of those words are used (e.g., SCA means "*S*cience, *C*hemistry *A*pplied" or simply "Applied Chemistry").
- The fourth character in the course code, 1, 2, 3, 4, or 0, represent Grade 9, 10, 11, 12, or an OAC respectively.
- The fifth character represents the level of difficulty: B for basic, G for general, or A for advanced.

For further information on course codes, refer to the *Manual for the Common Course Code* (Toronto: Ministry of Education, Ontario, 1986).

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